Safe Assets in Emerging Market Economies

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Abstract

Do local-currency sovereign bonds in emerging markets work as safe havens? In a sample of nine middle-income EMEs, I provide two estimates of their convenience yields arising from their safety and liquidity (one compared to private foreign assets and the other to domestic assets) after considering default, currency, and capital controls risks. A model of secondary markets with search frictions predicts that if a bond is a safe haven, its convenience yield responds positively to higher risk. I test this empirically and find that the safe asset status is conditional on the nature of risk: local-currency sovereign bonds hold a safe asset status against country-specific risk; against global risk factors, this status still holds but only compared to other domestic assets. Examining the Taper Tantrum and Covid-19 shocks, I find that the demand shift towards global safe assets isn't linked to increased default, currency, or regulatory risk.

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1 Introduction

What asset works as a safe haven in an emerging economy? Is it a foreign asset or a local-currency sovereign bond? Or both, but conditional on the type of risk? In this paper, I answer these questions by estimating convenience yields on EME sovereign bonds and employing their response to global and country-specific uncertainty as a measure of their use as a safe haven. "Convenience yields" measure the value for investors of the non-pecuniary benefits of an asset's liquidity and safety (Krishnamurthy and Vissing-Jorgensen, 2012), beyond the value of discounted future cash flows. I show that if an asset works as a safe haven, its safety/liquidity value should increase against increased risk. Over the past two decades, EME governments have deepened their local currency bond markets and improved their credit ratings significantly, and local currency debt now represents the lion's share of outstanding sovereign bonds in EMEs (BIS, 2020). This paper is the first attempt to estimate convenience yields of local-currency sovereign bonds across nine middle-income EMEs, understand their interactions with shocks of different nature, and contrast them with advanced economies.

There is substantial evidence of convenience yields on sovereign bonds in advanced economies and their role as safe assets. The safe asset status of government bonds influences equilibrium interest rates, expands government fiscal capacity, and acts as a transmission channel for large-scale central bank asset purchases[1] This paper underscores that, in emerging markets, government bonds can function as local safe assets, albeit competing with other global sources of safety. Recent work by Kekre and Lenel (2024) suggests that shifts in safety/liquidity demand contribute significantly to output volatility, both in the U.S. and globally.

How to think about safety in the context of EMEs? In this paper, I will refer to *relative* safety rather than absolute safety. These sovereign bonds will have risks: credit, liquidity, currency, etc. However, they will carry a convenience yield if they are *safer* than the relevant alternatives (which will be described throughout the paper) and if investors have a special

[1] See Del Negro et al. (2017a), Lenel, Piazzesi, and Schneider (2019), Jiang et al. (2022), Krishnamurthy and Vissing-Jorgensen (2011).

demand for this lower risk. For example, a financial intermediary with an inelastic demand for assets that offer higher nominal repayment or an asset that can be easily sold.

The convenience yields I will estimate may stem from safety or liquidity services, two distinct yet intertwined concepts. Liquidity pertains to the ease of selling assets for cash, while safety refers to an asset's valuation at face value without extensive analysis (Gorton, 2017). Safe assets typically exhibit high liquidity, and liquid assets tend to be safe, complicating empirical disentanglement, especially in EMEs, due to data constraints compared to the U.S.[2]

In the first part of the paper, I provide two estimations of convenience yields of EME local-currency sovereign bonds. The first, which I call the "domestic convenience yield", compares the local-currency sovereign bond to a domestic private local-currency asset with similar maturity but lacking equivalent safety and liquidity services, such as a term deposit. A way to rationalize this measure is to think of a domestic investor who holds a portfolio of domestic assets and measures her returns in the domestic currency. As shown in Krishnamurthy and Vissing-Jorgensen (2012), the spread between these assets gauges the safety/liquidity premium on the local-currency sovereign bond. Reliable daily data on domestic private local-currency assets is available for shorter maturities, which I match against corresponding local-currency sovereign bonds.

The second estimate, which I call the "dollar convenience yield", compares a synthetic dollar bond (a local-currency EME sovereign bond with its cash flows swapped into dollars via a forward contract) against non-Treasury-safe dollar bonds (such as highly rated U.S. corporate or U.S. agency bonds). This can be a relevant measure for a foreign investor who decides on a portfolio of assets in domestic and foreign currency and measures her returns in dollars. This estimate is relevant as foreign investors have increased their participation in EME local-currency sovereign bonds in recent years[3]. EME sovereign bonds will have either higher credit ratings or higher liquidity than some of these assets, justifying the existence of a convenience yield. Since both bonds are in dollars, the spread does not include currency

[2]Chaumont (2021) and Passadore and Xu (2022) provide models that characterize how credit risk and liquidity interact in secondary markets.

[3]See Onen, Shin, and von Peter (2023) and Du and Schreger (2022).

risk, which allows me to build on the methodology used by Du and Schreger (2016) and Du, Im, and Schreger (2018). I show that the spread between the two assets, in this case, is the sum of (1) the differential default risk, (2) regulatory risk, or the risk of losses produced by regulations imposed by the EME government (such as taxes on capital outflows or currency convertibility restrictions), (3) the covariance of the local currency with these risks, (4) frictions in swap and forward currency markets, and (5) the differential convenience yield. After accounting for the first four, I obtain the latter as a residual. Data is available for nine EMEs, and I consider assets with 5-year maturity.

The analysis reveals a significant convenience yield for EME local-currency sovereign bonds, which are robust across the two measures. The dollar measure indicates an average of nearly 30 basis points, while the domestic measure yields a higher average of 59 basis points. Consistent with convenience yields arising from safety/liquidity services, results show that convenience yields are increasing in the level of the monetary policy rate, reflecting the "money-like" properties of these sovereign bonds, as in Nagel (2016); and decrease in the supply of government debt, reflecting a downward-sloping demand curve for safety, as in Krishnamurthy and Vissing-Jorgensen (2012).

To assess sovereign bonds' role as safe havens, I propose a model that links the response of an asset's convenience yield to different sources of risk to its safe haven status. The model combines firms' liquidity needs with search frictions in secondary markets for bonds -as in Duffie, Garleanu, and Pedersen (2005) and Coppola, Krishnamurthy, and Xu (2024)- and flight to quality episodes - as in Caballero and Krishnamurthy (2008). Firms issue debt to investors to invest in projects but might face a liquidity shock: the project's revenues might come one period after the debt is due, creating a rollover risk and a demand for liquidity. To insure against this risk, firms can match their liquidity needs by investing in bonds issued by other firms or by the government that will pay exactly in the period their own debts are due. Trading in these bonds takes place in a secondary market with search frictions. From the investors' perspective, the probability of finding a buyer is higher the more firms demand the bonds. This generates a convenience yield: investors pay a premium for bonds that will be easier to sell.

Risk increases are captured by a higher probability of a large liquidity shock that will generate a liquidity shortage. As in Caballero and Krishnamurthy (2008), when the aggregate quantity of liquidity is limited, the firm is concerned that it will be caught in a situation where it needs liquidity, but there is not enough liquidity available. In this context, agents react by shedding risky financial claims in favor of safe and liquid claims. In such a situation, the model predicts that the bond that firms consider a safe haven will increase its convenience yield, generating a positive covariance with risk. Convenience yields will be higher because investors can easily sell them, and they are easy to sell because firms see the bond as a safe haven. Notice that this is not a model that explains the endogenous determination of a safe haven. Rather, it characterizes how, given that a bond is considered a safe haven, the convenience yield will correlate positively with those risks against which it is perceived as safe[4].

I test the model's prediction empirically by estimating the response of convenience yields to different sources of risk. I find that both the dollar and the domestic convenience yield increase against country-specific risk, as captured by the Economic Policy Uncertainty (EPU) index of Baker, Bloom, and Davies (2016) or the economic and financial risk index of the International Country Risk Guide (ICRG). However, the results are markedly different for global risk. Higher global risk sentiment, as captured by the VIX, is associated with a higher domestic convenience yield but with a lower dollar convenience yield.

The responses of the convenience yield against global and local risk factors suggest that their safe asset status depends on the nature of the shock and the benchmark asset. They are a safe haven compared to domestic private assets against both local and global risk. However, they are a safe haven compared to foreign private assets only against local risk. If we take the domestic and the dollar convenience yield as coming from a domestic and a global investor, respectively, then these results have important implications for EMEs. While domestic investors do consider the local currency sovereign bond as a safe asset for local and global risk, foreign investors only do so for local shocks. This can add an extra source of volatility and fiscal strain during episodes of global uncertainty. In addition, these results imply that the commonly held view that capital inflows to EMEs are mostly determined by

[4]The endogenous evolution of a safe haven status is analyzed in, for example, He, Krishnamurthy, and Milbradt (2019) and Brunnermeier, Merkel, and Sannikov (2024)

yield-oriented foreign investors is strongly dependent on the nature of the shock.

To gain further insight, I analyze two exogenous shocks to EMEs: the Taper Tantrum (which signaled the end of dollar liquidity supply via the end of the Fed's large-scale asset purchases) and the Covid pandemic (which triggered a global flight to safety). While the global-investor convenience yield increased amid scarcer liquidity during the Taper Tantrum, it significantly dropped against the flight to safety in March 2020. Surprisingly, this drop was not mechanically driven by the rise in credit risk or higher risk aversion but by a switch in investors' preferences away from EME bonds and towards assets denominated in dollars.

The final section discusses alternative sources of convenience yields in EMEs. According to recent models of default and liquidity risks, they could arise in the context of collateral constraints, liquidity regulations, or the interaction between liquidity and credit risk. In addition, it discusses how these convenience yields relate to recent papers studying the demand for EMEs sovereign bonds using more disaggregated data on holdings by different investor types.

Related Literature. The empirical literature is ample in the study of the safety of U.S. Treasuries against comparable dollar private debt (Krishnamurthy and Vissing-Jorgensen, 2012; Greenwood, Hanson, and Stein, 2015; Nagel, 2016) and against sovereign bonds of other advanced countries (Du, Im, and Schreger, 2018; Jiang et al., 2021). This paper is the first attempt to apply this empirical work to pricing local-currency sovereign bonds in emerging markets. Indeed, going beyond advanced economies can help us to better understand the determinants and the role of safe assets.

Convenience yields have been shown to be important in explaining exchange rate levels and puzzles (Engel, 2016; Jiang, Krishnamurthy, and Lustig, 2021; Engel and Wu, 2023); can lower equilibrium interest rates (Del Negro et al., 2017a); can increase the government's fiscal capacity (Jiang et al., 2022); and are a channel for the effectiveness of large scale asset purchases (Krishnamurthy and Vissing-Jorgensen, 2011; Del Negro et al, 2017b). Moreover, they are a relevant driver of global capital flows in Jiang, Krishnamurthy, and Lustig (2019) and Kekre and Lenel (2024).

Diamond and Van Tassel (2023) estimate convenience yields using domestic assets for G10 countries, which has some similarities with the domestic investor's convenience yield I estimate. My analysis of sovereign bonds in emerging markets is more comprehensive since I also provide a convenience yield from the perspective of foreign investors. In addition, I provide a model to understand how convenience yields can arise along with credit and regulatory risks.

The literature has offered many rationales for the pricing of a convenience yield: insurance provision against idiosyncratic risk (Brunnermeier, Merkel, and Sannikov, 2024), liquidity regulations and financial repression (Payne and Szoke, 2024), bonds' use as collateral (Devereux, Engel, and Wu, 2023; Mendoza and Quadrini, 2023). In this paper, the novelty relies on convenience yields arising from their use as a safe haven against heightened risk. However, this view is not inconsistent with the existing ones, and the last Section discusses more thoroughly how they can be related.

This paper also adds to recent studies of the drivers of capital inflows to EMEs. While the conventional view assumes yield-oriented investors that respond to interest rate differentials with the U.S., recent papers have found a role for spillovers in risk perceptions (Kalemli-Ozcan, 2019; Kalemli-Ozcan and Varela, 2023). This paper complements this view, and the convenience yields I estimate can be thought of as one component of the risk perceptions studied in Kalemli-Ozcan (2019). In particular, a drop in the dollar convenience yield increases the risk premia attached to EMEs' sovereign bonds.

Finally, by documenting the existence of domestic safe assets and their interaction with the U.S. Treasury, this paper contributes to the literature on safe assets shortages (Caballero, Farhi, and Gourinchas, 2016, 2017). Recently, Mendoza and Quadrini (2023) quantified how the reliance on U.S. debt as the sole source of safety has increased global financial instability. The line of work of my paper could contribute to the questions of what is required to expand the supply of global safe assets or reduce the global demand for U.S. safe assets.

The paper proceeds as follows. Section 2 estimates the convenience yields. Section 3 addresses the role of sovereign bonds as safe havens. Section 4 discusses models that can rationalize the findings and their relation to recent results about asset demand. Section 5 concludes.

2 Estimation of EME Local-Currency Convenience Yields

2.1 A Simple Asset Pricing Model

To provide a framework for deriving and estimating convenience yields, I extend the methodology in Krishnamurthy and Vissing-Jorgensen (2012). An asset earns a convenience yield if (1) it has lower risk or higher liquidity than an alternative asset with the same cash flows, and (2) investors derive non-pecuniary benefits from that lower risk. The latter is captured in a reduced-form way by including bond holdings in the investor's utility function.

I provide two measures of the convenience yield, which differ in the "alternative asset" used in the comparison. In the first, I compare the local-currency sovereign bond against a private domestic asset with higher credit risk and/or lower liquidity. The second compares the local-currency sovereign bond against a private foreign dollar asset with higher credit risk and/or lower liquidity.

The first could be thought of as capturing the valuation of a "domestic" investor who compares returns of only domestic assets and measures returns in the domestic currency of the EME. The second could be thought of as capturing the valuation of a "global" or foreign investor who measures returns in dollars and compares the local-currency sovereign bond with a non-Treasury safe dollar bond (an agency or a highly-rated corporate bond).

In the real world, the markets for these assets are not as segmented, and, of course, a foreigner can invest in a private domestic asset or a local can invest in a private dollar bond. However, for ease of exposition, I will refer to the convenience yields as coming from these two "types" of "investors".

For any of these investors, the framework modifies a standard representative agent model to include a term to capture that agents derive utility directly from holding a "convenience" asset. A representative investor maximizes

$$E\sum_{t=1}^{\infty}\beta^t u(c_t+\nu(\theta_t^i,\mathrm{GDP}_t^i)) \tag{1}$$

where $i \in \{d, f\}$ for domestic investor or foreign investor, respectively. c_t is consumption from an endowment stream, and the second term represents "convenience" benefits of holding bonds that provide safety or liquidity services, θ_t^i. The assets that enter into θ_t^i will be specified later for each investor type. The agent's income is GDP_t^i, measured in real terms. Problem (1) shows that both investors differ in the assets held in their portfolio and in the endowment stream they receive, GDP_t^i, that will determine their risk-free rate and their pricing kernel.

The function $\nu(\cdot)$ is a reduced-form way of capturing non-pecuniary benefits from the safety and liquidity of certain bonds. For example, the benefits of holding a liquid asset that eases transactions (as collateral) or from having an asset that promises stable nominal returns. In this paper, I will not empirically distinguish between safety and liquidity benefits. These assets could be money, sovereign bonds, or private assets that share, to some extent, these characteristics (like insured bank deposits, central bank reserves, or corporate bonds of highly rated companies).

Assume that the convenience function is homogeneous of degree one in GDP_t^i and θ_t^i. Thus define $v(\frac{\theta_t^i}{\text{GDP}_t^i})\text{GDP}_t^i \equiv \nu(\theta_t^i, \text{GDP}_t^i)$. Assume that the convenience function is increasing in $\theta_t^i/\text{GDP}_t^i$, but the marginal convenience benefit is decreasing in $\theta_t^i/\text{GDP}_t^i$, and $\lim_{\theta_t^i/\text{GDP}_t^i \to \infty} v'(\theta_t^i/\text{GDP}_t^i) = 0$.

The Euler equation for holdings of a convenience asset, θ_t^i, gives the following expression for its price, P_t (to simplify, assume no default risk, which will be introduced later):

$$P_t = E_t[M_{t+1} P_{t+1} \Lambda_t^i]$$

where $M_{t+1} = \beta \frac{u'(C_{t+1})}{u'(C_t)} \frac{Q_t}{Q_{t+1}}$ is the pricing kernel and Q_t is the price level. $\Lambda_t^i \equiv 1/(1 - v'(\theta_t^i/\text{GDP}_t^i))$ captures the marginal benefits investor i derives from these bonds. A positive marginal value of convenience by investor i, $v'(\cdot)$, raises Λ_t^i, and therefore raises the price of the bond, P_t.

2.1.1 Domestic convenience yield

Consider a domestic investor, $i = d$, with the alternative of investing in a domestic sovereign bond (with some level of default risk) and a domestic private asset but with higher risk and thus lower convenience services, for example, a term deposit on a local commercial bank.

The portfolio of convenience assets of this domestic investor is given by:

$$\theta_t^d = \theta_t^M + \kappa_t^{T,d} \theta_t^T + \kappa_t^{P,d} \theta_t^P \tag{2}$$

where θ_t^M, θ_t^T, and θ_t^P correspond to holdings of money or cash (as the most liquid domestic asset), sovereign bonds, and alternative private substitutes, respectively. The latter two are of the same maturity. $\kappa_t^{T,d}$ and $\kappa^{P,d}$ represent the investor's d relative preference for the convenience service of assets other than money. Both are assumed to be less than one. Time variation in $\kappa_t^{T,d}$ and $\kappa^{P,d}$ could come from changes in their safe asset status: if, in certain states of the world, investors switch preferences to the safety and liquidity services of other assets, beyond what would be explained by variations in credit risk.

Proposition 1. *The spread between the yield of a local-currency domestic private asset, y_t^P, and the yield of a local-currency sovereign bond, y_t^T, of the same maturity, can be decomposed as follows:*

$$y_t^P - y_t^T \approx (\lambda_t^{T,d} - \lambda_t^{P,d}) + (l_t^P - l_t^T) + (\xi_t^{T,d} - \xi_t^{P,d}) \tag{3}$$

where $\lambda_t^{T,d}$ measures the marginal safety/liquidity services the domestic investor (d) derives from the sovereign bond (the convenience yield), $\lambda_t^{T,d} \approx \kappa_t^{T,d} v'(\theta_t^d/GDP_t^d)$, and $\lambda_t^{P,d} \approx \kappa_t^{P,d} v'(\theta_t^d/GDP_t^d)$; l_t^P and l_t^T are, for each asset, the expected default plus a risk premium associated with the covariance between default and the stochastic discount factor; and $\xi_t^{T,d}$, $\xi_t^{P,d}$ are the covariances between credit risk and the convenience yield.

Proof: see the Appendix.

The domestic measure of the convenience yield of local-currency sovereign bonds is given by:

$$CY_t^d = \lambda_t^{T,d} - \lambda_t^{P,d} = (\kappa_t^{T,d} - \kappa_t^{P,d}) v'(\theta_t^d/\mathrm{GDP}_t^d) \tag{4}$$

Equation 4 shows that what I call the "domestic convenience yield" is really a *differential* convenience yield because I allow the domestic private asset to provide some (but lower) convenience benefits. Henceforth, whenever I mention the "domestic convenience yield", I will refer to this differential convenience yield.

The term $\xi_t^{T,d}$ is an important one, and it is not present in the model of Krishnamurthy and Vissing-Jorgensen (2012). Since investors will derive no safety benefits from an asset with higher credit risk, it is likely that states of the world of higher credit risk coincide with states of lower convenience yields. Thus, the covariance between credit risk and the convenience yield will be negative, $\xi_t^{T,d} < 0$. Not accounting for this will overestimate the actual convenience yield of the bond. To correctly capture CY_t^d in the data, I will have to control for measures of credit risk.

What increases the convenience yield on sovereign bonds, CY_t^d? First, a lower supply of government debt, $\theta_t^T/\text{GDP}_t^d$, or a lower supply of substitutes, $\theta_t^P/\text{GDP}_t^d$. Second, if sovereign bonds provide the same liquidity services as money, then a lower supply of $\theta_t^M/\text{GDP}_t^d$ will also increase in the convenience yield. Third, variations in the relative convenience service. For example, losing the safe asset status (switch in investors preferences towards other safe assets) can reduce $\kappa_t^{T,d}$.

How will I recover CY_t^d in the data? I will take data on spreads between the two types of assets, $y_t^P - y_t^T$, as a measure of the convenience yield of local-currency sovereign bonds. Although Proposition 1 shows that this spread also includes differential default risk and its covariance with convenience yields, in Section 3, I will show that $y_t^P - y_t^T$ is driven by the domestic convenience yield. This is the same empirical strategy used by Krishnamurthy and Vissing-Jorgensen (2012).

In the lack of data for highly-rated domestic corporate bonds of longer maturities, I use yields on private assets with 1-year maturity, such as term deposits or unsecured interbank term loans, which I compare with 1-year local-currency sovereign bonds. Term deposits have roughly the same credit risk as government debt (local banks hold most local-currency government debt) but cannot be redeemed before maturity, and therefore, spreads using these assets will measure mainly a liquidity premium. 1-year interbank loans are not collateralized, and thus spreads that use these assets will measure a mix of a safety and a liquidity premium.

The Appendix describes the data sources for each country.

2.1.2 Dollar investor's convenience yield

Consider a foreign investor, $i = f$, that measures her returns in dollars and whose portfolio of convenience assets is given by:

$$\theta_t^f = \theta_t^{\$M} + \kappa_t^{T,f}\theta_t^T + \kappa_t^{US,f}\theta_t^{US} \tag{5}$$

where $\theta_t^{\$M}$ correspond to dollar money and near-money assets such as U.S. Treasuries; θ_t^T correspond to synthetic dollar bonds: a local-currency sovereign EME bond with all the cash flows swapped into dollars via a forward contract; θ_t^{US} correspond to holdings of non-Treasury safe dollar bond such as a highly rated U.S. corporate bond or a U.S. agency bond. The latter two are of the same maturity. $\kappa_t^{T,f}$ captures the relative convenience service investor f derives from local-currency sovereign bonds of EMEs. As in the previous subsection, time variation in $\kappa_t^{T,f}$ could come from changes in investors' preference for certain assets during, for example, a flight to quality episode.

Proposition 2. *The spread between the yield on a non-Treasury safe dollar bond, y_t^{US}, and the yield on the synthetic dollar bond, $y_t^T - \rho_t$, (the yield of the local-currency bond of an EME, y_t^T, minus the forward premium between the local currency and the dollar, $\rho_t = logF_{t+1} - logS_t$, where F_{t+1} and S_t are the forward and spot exchange rates, respectively, both expressed as units of local currency per dollar) can be decomposed as follows:*

$$\begin{aligned}\underbrace{y_t^{US} - (y_t^T - \rho_t)}_{Spread} = & \underbrace{\lambda_t^{T,f} - \lambda_t^{US,f}}_{Diff.\ Convenience\ yield} \\ & + \underbrace{(l_t^{US} - l_t^T)}_{Differential\ default\ risk} - \underbrace{k_t}_{Regulatory\ risk} + \underbrace{(q_t^T + p_t + (\xi_t^{T,f} - \xi_t^{US,f}) + \psi_t^{T,f})}_{Covariances}\end{aligned} \tag{6}$$

where $y_{rf,t}^{US}$ is the dollar risk-free rate; $\lambda_t^{US,f}$ measures the marginal safety/liquidity services the dollar investor (f) derives from this US bond (the convenience yield); l_t^{US} is the expected default plus a default risk premium, and $\xi_t^{US,f}$ is the covariance between default risk and the convenience yield. Similarly, $\lambda_t^{T,f}$ is the convenience yield the investor f derives from the sovereign bond of the EME; $l_t^T - q_t$ is the expected loss upon default, l_t^T, net of the covariance between default and currency risk, q_t^T; $k_t - p_t$ are the expected losses upon the imposition of regulations, k_t, net of the covariance between the risk of regulations and currency risk, p_t; and $\xi_t^{T,f}$ and $\psi_t^{T,f}$ the covariance of default risk and the convenience yield, and the covariance between the convenience yield and capital control risk, respectively.

Proposition 2 compares the yields of two bonds denominated in dollars. Therefore, the spread between the two does not contain currency risk. If the CIP condition holds for risk-free rates, then $y_{rf,t} - \rho_t = y_{rf,t}^{US}$. In this case, the dollar convenience yield on local-currency sovereign bonds of EMEs, which is a *differential* convenience yield, corresponds to:

$$
\begin{aligned}
CY_t^f \equiv & \lambda_t^{T,f} - \lambda_t^{US,f} \\
= & (\kappa_t^{T,f} - \kappa_t^{US,f}) v'(\theta_t^f / \mathrm{GDP}_t^f) \\
= & \left[y_{rf,t} - \left(y_t^T - l_t^T + q_t^T - k_t + p_t + \xi_t^{T,f} + \psi_t^{T,f} \right) \right] - \left[y_{rf,t}^{US} - \left(y_t^{US} - l_t^{US} + \xi_t^{US,f} \right) \right]
\end{aligned}
\tag{7}
$$

The second line in Equation (7) gives the model's interpretation of the dollar convenience yield, and the third line gives its empirical counterpart.

In the second line, if EME sovereign bonds share the liquidity services provided by money, a lower supply of dollar liquid assets such as dollar money or U.S. Treasuries will increase the dollar convenience yield on EME sovereign bonds through $v'(\theta_t^f / \mathrm{GDP}_t^f)$. In addition, a higher default risk of EME sovereign bonds mechanically lowers the convenience yield, since investors will derive lower benefits if there is higher risk. Losing the safe asset status during a flight-to-quality episode would also reduce $\kappa_t^{T,f}$, lowering the convenience yield.

In the third line, the empirical counterpart in Equation (7) shows that $\lambda_t^{T,f}$, in the first square bracket, corresponds to the spread between the local-currency risk-free rate and the sovereign bond (adjusted by all risks to resemble a riskless return). Similarly, in the second square bracket, $\lambda_t^{US,f}$ corresponds to the spread between the dollar risk-free rate and the dollar bond (after adjusting for its default risk to make it comparable).

The term k_t captures the risk of regulations imposed by the local government that can inflict additional losses upon investors: taxes on capital outflows, currency convertibility restrictions, and any other forms of capital controls. These are relevant as most of the foreign participation in local-currency sovereign bonds has been through domestic markets under domestic law. Both the default risk and k_t are net of their covariance with currency risk, q_t^T and p_t, respectively. Intuitively, when dollar investors invest in local-currency EME sovereign bonds, default or capital controls cause an additional, indirect loss on them. They not only receive less local currency back, but those cash flows are now worth less if the currency depreciates upon these events. The yield on the synthetic bond does not capture the latter, as currency risk is being hedged. Therefore, the synthetic bond yield underestimates the loss risk upon these events.

The new term $\psi_t^{T,f}$ captures the covariance between the convenience yield and the risk of capital controls. Since higher regulatory risk will lower the non-pecuniary benefits earned by foreign investors, it is likely that states of the world with higher capital control risk coincide with states of lower convenience yields. Thus, the covariance between regulatory risk and the convenience yield will be negative. Similar to the case of $\xi_t^{T,f}$, not accounting for this will overestimate the actual convenience yield of the bond. To correctly capture CY_t^f in the data, I will have to control for measures of credit risk.

How will I recover CY_t^f in the data? Data is available for the spread between the two bonds. Then, I will gather data on differential credit risk (through CDS spreads), regulatory risk plus covariances (explained below), and any residual left will be attributable to $\lambda_t^{T,f} - \lambda_t^{US,f}$.

Regulatory risk. The main challenge is finding a proxy for the regulatory risk and the covariances in the right-hand side of Equation (6). I rely on the spread between the swapped local-currency bond and the bond denominated in foreign currency issued offshore. The latter is generally issued under international law and, therefore, less subject to the unilateral imposition of capital controls and other regulations.

Proposition 3. *Let Φ_t^{FC} denote the spread between the yield of the synthetic bond, $y_t^T - \rho_t$, and the yield of the sovereign bond of the same EME issued in dollars, y_t^{FC}. Then,*

$$\begin{aligned} \Phi_t^{FC} &\equiv y_t^T - \rho_t - y_t^{FC} \\ &\approx (\lambda_t^{FC,f} - \lambda_t^{T,f}) + (l_t^T - l_t^{FC} - q_t^T) + (k_t - p_t) + (\xi_t^{FC,f} - \xi_t^{T,f}) - \psi_t^{T,f} \end{aligned} \tag{8}$$

where $\lambda_t^{FC,f}$ and l_t^{FC} are the convenience yield and the default risk of the sovereign bond issued in dollars, respectively.

The expression Φ_t^{FC} will be approximately equal to the term on regulatory risk plus covariances in (6). However, it also adds two new terms. First, the differential credit risk between foreign and local currency bonds. I will assume that $l_t^{FC} \approx l_t^T$. I refer to the discussion by Du and Schreger (2016), where they conclude that recent history in emerging markets does not give a clear higher probability of defaults or higher haircuts in either currency. None of the countries have defaulted in the time covered in the sample (starting in December 2007). Before that, only Turkey selectively defaulted on local-currency debt in 1999, and Indonesia selectively defaulted on foreign-currency debt in 2002.

Second, the differential convenience yield between foreign currency bonds and swapped local currency bonds, $\lambda_t^{FC,f} - \lambda_t^{T,f} \equiv tau_t$. Both convenience yields are in dollars and could be different if the two bonds have either different credit risks (already discussed) or different liquidity. As for liquidity, forward contracts used in the swapped local-currency bond have significantly larger bid-ask spreads and lower trading volume than bonds. Since investors in the swapped local currency bonds have short positions in the less liquid swap market, overall, they have better liquidity than holding bonds denominated in foreign currency. I will proxy the differential convenience yield with the liquidity risk in currency swaps, measured by their bid-ask spread.

Other financial frictions. The correction using the bid-ask spread of currency swaps also addresses the empirical findings of Jiang, Krishnamurthy, and Lustig (2021), who estimate, for the sample of G10 countries, that most of the convenience of swapped local-currency bonds comes from being swapped into dollars, not from the actual bond. This follows from the liquidity of the dollar currency, which they claim makes any asset denominated in dollars inherit the convenience of the currency. I take the view that, in the case of swapped local currency bonds, their "dollarness" must depend on the liquidity of the forward markets. If a foreigner is investing in a swapped local currency bond, the liquidity of the dollar currency is well captured by how easy it is to swap the local currency into dollars, which will depend on the liquidity of the EME forward market.

Engel and Wu (2023) and Du, Im, and Schreger (2018) also consider an additional source of swap market frictions: it could be that the observed forward premium, ρ_t, is different than the hypothetical premium that ensures CIP for risk-free rates. In this case, we would have $\tau_t^{CIP} \equiv y_{rf,t} - \rho_t - y_{rf,t}^{US} > 0$, and the empirical counterpart in Equation 6 would no longer capture the full dollar convenience yield. Du, Tepper, and Verdelhan (2018) explain that CIP deviations in risk-free rates can arise when the dollar rate is lower than the swapped foreign rate, and banks face balance sheet costs that prevent them from arbitraging the difference. When global financial intermediaries are constrained and demand for dollar liquidity is strong, this shows up as a positive CIP deviation and can lead to the mispricing of forward contracts. This friction shows up twice in my derivation (in Equation (6) and again in Equation (8)), and they cancel out, and therefore it does not affect my estimation.

The result in Proposition 4 can be substituted in Equation (6), then move the differential convenience yield to the left-hand side and obtain the following:

$$\lambda_t^{T,f} - \lambda_t^{US,f} = y_t^{US} - (y_t^T - \rho_t) + (l_t^T - l_t^{US}) + \Phi_t^{FC} - \tau_t + (\xi_t^{US,f} - \xi_t^{FC,f}) \tag{9}$$

On the left-hand side, I have the desired convenience yield of EME sovereign bonds against non-Treasury-safe dollar bonds. The Appendix describes all data sources for bond yields, forward premia, credit risk, and Φ_t^{FC} on the right-hand side of Equation (9). τ_t corresponds to the liquidity risk in forward markets. To account for $\xi_t^{US,f} - \xi_t^{FC,f}$, I will show in Section 3 that $\lambda_t^{T,f} - \lambda_t^{US,f}$ on the left-hand side is not driven by risk aversion, recessions, or political risk.

What are the non-Treasury dollar bonds, y_t^{US}, in the data? Three series are available. First, the 5-year yield on Resolution Funding Corporation (Refcorp) bonds. As suggested by Longstaff (2004), Refcorp bonds are effectively guaranteed by the U.S. government and are subject to the same taxation, but are not as liquid as Treasuries. The other two are the ICE Bank of America index for AAA and BBB-rated corporate bonds in the US. They track the performance of US dollar-denominated investment grade-rated corporate debt publicly issued in the US domestic market, including all maturities over one year.

How do these dollar assets compare with the local-currency sovereign bonds in EMEs regarding safety and liquidity? The Refcorp and AAA-rated corporate bonds have higher credit ratings than the nine EMEs considered. According to Moody´s, credit ratings are Baa1 on average, ranging from A1 (for Chile) to B3 (for Turkey). Thus, it is likely that the convenience yield estimated through these two spreads includes mostly a liquidity premium, not a premium for their safety. However, most of these countries' credit ratings are above the BBB-rated corporate bonds, so the convenience yields calculated using this index might capture both a safety and a liquidity premium.

The nine countries for which I estimate the dollar convenience yield are Brazil, Chile, Colombia, Indonesia, Mexico, Peru, the Philippines, South Africa, and Turkey. This selection is based solely on data availability.

The Internet Appendix discusses standard features and financial frictions of EME financial markets that could potentially affect the estimation of the convenience yield according to Equation (9): the issuance of Eurobonds (local-currency sovereign bonds issued under international law and thus not subject to regulatory risk), and the possibility of market segmentation between foreign vs. local investors. It also describes the role of Φ_t^{FC} and shows its evolution in the case of Brazil, which is a country that implemented capital controls during the sample period.

2.2 Analysis

Table 1 shows summary statistics for the two measures of the local-currency convenience yield of sovereign bonds. These are calculated at the daily frequency. Columns 1-3 provide moments for the dollar investors convenience yield ($\lambda_t^{T,f} - \lambda_t^{US,f}$ in Equation (9)), and Columns 4-6 do the same for the domestic convenience yield ($y_t^P - y_t^T$ in Equation (2)). The last column shows the correlation between the two measures.

Overall, both measures show positive and sizable averages. Regarding the domestic convenience yield, I omit data for Peru and the Philippines because their benchmark interbank rate was discontinued after 2020. I also omit the data for Brazil since the spread is taken against a 1-year interest rate swap, and it is very likely that foreigners are the marginal investors for these instruments. The empirical results in the next Section are nonetheless robust to including all of these three series.

Chile and Mexico have the largest average dollar convenience yield among the nine countries. Column 7 shows that the correlation between the two measures is positive and significant. Notice that the correlation between the two measures is not significantly different from zero in Turkey. However, Column 2 shows that local-currency sovereign bonds in Turkey enjoy no convenience yield from the dollar-investor perspective. This is consistent with evidence that Turkey has the lowest foreign investors' participation in local-currency sovereign bonds among these nine EMEs (according to BIS data), which has dropped sharply in recent years.

Figure 1 shows the evolution of the dollar-investor's convenience yield computed for the 5-year maturity. A common pattern emerges: first, an increase around 2011-2012 (that

Table 1: Summary Statistics

	Dollar-investor's CY			Domestic CY			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Country	Sample starts	Mean	Std	Sample starts	Mean	Std	Corr
Brazil	June 2010	28.62	30.31	n.a.	n.a.	n.a.	-
Chile	April 2011	45.98	26.61	May 2010	60.63	33.42	0.3253***
Colombia	December 2007	16.76	26.34	June 2005	53.72	64.76	0.4749***
Indonesia	February 2015	27.82	15.71	February 2003	85.03	56.74	0.2582***
Mexico	December 2007	44.42	24.27	July 2011	19.26	14.1	0.5076***
Peru	December 2007	29.42	27.00	n.a.	n.a.	n.a.	-
Philippines	December 2007	18.40	31.72	n.a.	n.a.	n.a.	-
South Africa	December 2013	27.10	35.57	April 2000	66.6	47.24	0.1581***
Turkey	December 2007	-4.27	27.11	October 2006	73.45	101.17	0.0167
United States	February 2006	46.44	12.79				

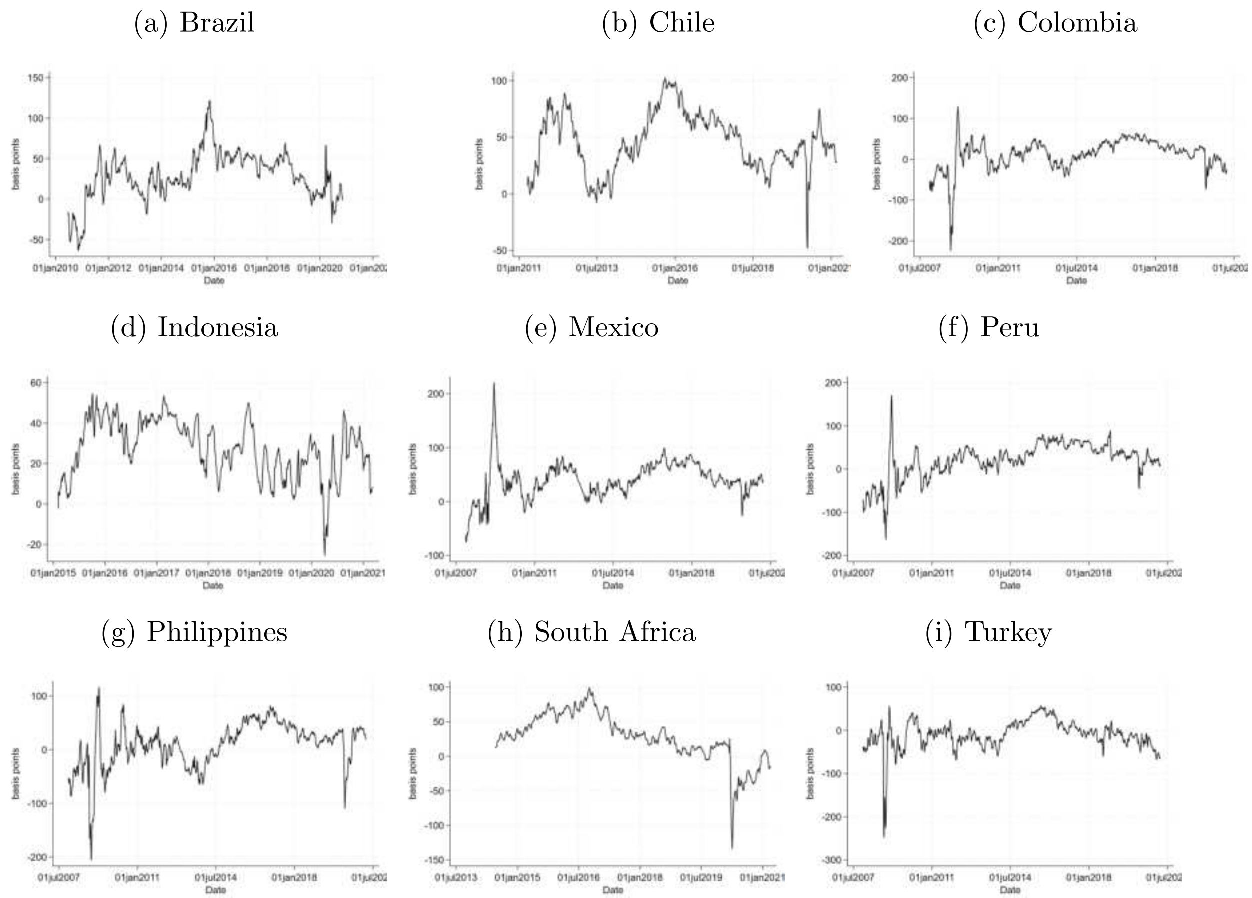
Notes: Daily frequency. The sample ends on March 9, 2021. Mean and std are calculated from 1/1/2010 onward. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

coincides with the Euro debt crisis, a period when some EMEs had lower default risk than some European countries), and another increase starting around 2014-2015, when the Fed started raising rates and dollar liquidity became scarcer. Second, sharp drops during crises, especially the Covid shock in 2020. Significant drops in local-currency convenience yields happened in Mexico, Peru, Chile, Indonesia, the Philippines, and South Africa, while Brazil did not experience a significant reduction.

In the Internet Appendix, I perform additional analysis on the evolution of the EME convenience yield computed against the convenience yield of the U.S. Treasury (the "U.S. Treasury premium" as calculated in Du, Im, and Schreger (2018) for G10 countries).

Figure 2 shows the evolution of the domestic convenience yield for the 1-year sovereign bond. They usually increase in times of crisis (Chile in 2020, South Africa in 2008) with a few exceptions (Indonesia in 2008 and Mexico in 2020).

Figure 1: Dollar-Investor's Convenience Yield on 5-Year Local-Currency Sovereign Bonds



Notes: Figure shows the 14-day moving average of the dollar-convenience yield for each country.

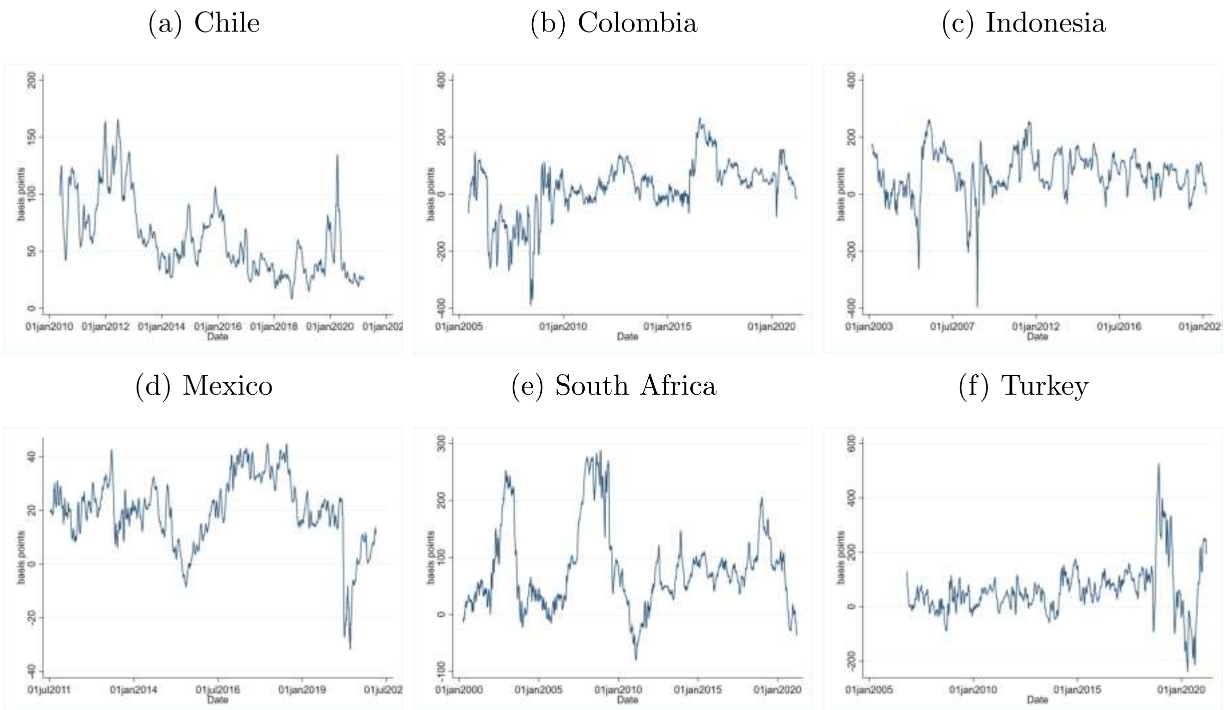
2.3 The Role of Safety/Liquidity Services

This section provides empirical evidence that the estimated convenience yields capture non-pecuniary services related to safety/liquidity services. I follow Krishnamurthy and Vissing-Jorgensen (2012), Greenwood, Hanson, and Stein (2015), and Nagel (2016) and set up the following regression:

$$cy_{i,t} = \beta_1(\text{Gov. debt supply/GDP})_{t-1} + \beta_2 i^{MP}_{t-1} + \beta_3 i^{US}_t + \beta_4 X_t + c_i + \tau_t + \epsilon_{i,t} \qquad (10)$$

where i is currency/country, t is time, and $cy_{i,t}$ is either the dollar investors' or the domestic convenience yield. The variable $(\text{Gov. debt supply/GDP})_t$ is the outstanding supply of "safe assets". This is proxied by either the local-currency sovereign debt or the U.S. government debt supply. Both quantities are net of central bank holdings. For the domestic

Figure 2: Domestic Convenience Yield on 1-Year Local-Currency Sovereign Bonds



Notes: Figure shows the 14-day moving average of the domestic convenience yield for each country.

convenience yield, this is a proxy for θ_t^T/GDP_t^d in the model's Equations (2) and (4), and for the dollar convenience yield, a proxy for $\theta_t^{\$M}/GDP_t^f$ in (5) and (7). If there is a demand for safety and liquidity from investors, the coefficient β_1 represents the slope of the demand curve for safe assets and should, therefore, be negative.

The variables i^{MP} and i_t^{US} correspond to the level of the monetary policy rate in each EME and the U.S., respectively. This represents the price of the most liquid asset in the economy: money or its near substitutes, such as central bank reserves or private liquid deposits. In terms of the model above, this is a proxy for θ_t^M and $\theta_t^{\$M}$. Higher levels of interest rates are associated with lower supply of money assets, driving up their price. As explained in Nagel (2016) and Diamond and Van Tassel (2023), if government debt shares the money properties of very liquid assets, then its convenience yield should respond positively to the price of money, i.e., the level of the monetary policy rate.

Lastly, X_t refers to relevant control variables. Given that, according to Proposition 1, the measure of the domestic convenience yield $(y_t^P - y_t^T)$ might include a component of credit risk, I control for proxies of default risk and risk aversion to show that they do not drive the results. For the dollar convenience yield, these controls are important to make sure that the residual differential convenience yield does not capture any covariance of the convenience yield with credit risk (the ξ_t's in the previous section).

The independent variables are lagged one month to avoid endogeneity and reverse causality as much as possible. The variables c_i and τ_t are country and time-fixed effects, respectively. Year fixed effects capture time-varying unobserved variables common to all countries. In this sense, it controls for global variables other than the supply of U.S. debt and the level of the federal funds rate. I double-clustered the standard errors across year and country.

Table 2 shows the results. Columns 1 and 4 show that both measures respond positively to the level of the monetary policy rate. As explained above, this is the sign one expects if EME local-currency convenience yields arise from liquidity-related benefits: a higher monetary policy rate is related to a lower supply of money-related assets, increasing the convenience yield on other near-money assets, such as government debt. The local monetary policy rate has a more significant effect on the domestic convenience yield. In contrast, the U.S. monetary policy rate significantly impacts the dollar convenience yield. This can be explained by how both convenience yields are estimated: the former measures returns in local currency, while the latter measures returns in dollars.

Regarding the supply variable, in Columns 1 and 4, the supply of government debt negatively affects the convenience yield. The supply of local-currency bonds has a significant adverse effect on the domestic convenience yield, and the supply of U.S. government debt has a negative impact on the dollar-investor's convenience yield. This suggests that both measures of convenience yields correctly capture the relevant currencies for each investor: a larger supply of local-currency government bonds affects more the convenience yield that measures returns in the local currency and analogously for the dollar investor.

The negative coefficient on the relative supply of U.S. Treasuries is a crucial result. As explained above, if the measures of local-currency convenience yield capture demand for safety and liquidity, then the estimated coefficient represents the slope of the demand for safe assets and, therefore, should be negative.

Default and liquidity risk and the risk premia investors charge are important components

Table 2: Determinants of Convenience Yields

	Dep. var.: dollar CY			Dep. var.: domestic CY		
	(1)	(2)	(3)	(4)	(5)	(6)
Local MP rate$_{t-1}$	0.350	0.083	0.343	11.00***	8.140**	10.95***
	(0.547)	(0.739)	(0.544)	(1.478)	(3.147)	(1.462)
U.S. MP rate$_{t-1}$	11.58***	9.131**	10.90***	-0.163	-3.196	-6.891
	(3.817)	(3.857)	(4.012)	(9.470)	(10.69)	(11.92)
$\log(\frac{\text{Local gov debt}}{GDP_{local}})_{t-1}$	8.27	2.89	8.219	-31.58***	-32.47***	-31.87***
	(8.510)	(8.288)	(8.51)	(10.62)	(9.551)	(10.57)
$\log(\frac{\text{U.S. gov debt}}{GDP_{US}})_{t-1}$	-135.9***	-132.0***	-137.2***	111.0	107.98	93.25
	(45.04)	(43.63)	(46.86)	(86.14)	(99.17)	(88.28)
slope$_{local,t-1}$		-0.107			-11.29	
		(1.550)			(7.441)	
slope$_{US,t-1}$			-1.378			-10.49
			(4.019)			(9.162)
Constant	-345.1***	-338.9***	-345.3***	8.30	22.41	3.519
	(82.13)	(80.29)	(83.1)	(126.8)	(139.4)	(125.7)
Observations	1,137	1,103	1,137	967	918	967
R-squared	0.660	0.676	0.663	0.331	0.346	0.332

Notes: Data are at monthly frequency. All columns include country and year-fixed effects. Standard errors are double-clustered by country and year. Start dates vary among countries but end in March 2021 for all. U.S. debt and EME local-currency debt-to-GDP variables are net of the central bank's holdings. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

of bond spreads, especially in EMEs. Columns 2 and 5 include the yield curve's slope as a further control. Columns 3 and 6 use the slope of the dollar yield curve. The slope of the yield curve is known to predict the excess returns on stocks, and it is a commonly used risk factor when estimating risk premia in bond markets (Campbell and Shiller, 1991; see Baumeister (2023) for a comprehensive review). For example, if investors are more risk-averse in a recession, they will demand a higher risk premium to hold the sovereign bond or its private substitutes. Thus, the slope of the yield curve serves as a measure of variation in the risk premium component of the bond spread, that is, the terms involving the covariances of convenience yields in Section 2. In addition, to the extent that default and liquidity risk are likely to vary with the business cycle, the slope variable can furthermore help control for the expected risks in the yield spread.

I measure the slope as the spread between the 10-year sovereign bond yield and the 3-month yield in the domestic currency. The estimated coefficients for the supply of debt and the monetary policy rate are robust to the inclusion of the slope variable, although it reduces the magnitude of the estimated coefficient of the monetary policy rate. This suggests that results are not driven by the risk premia investors charge on EME debt and that the estimated convenience yields are correctly capturing the non-pecuniary benefits of safety and liquidity. These results are robust to including the output gap as an alternative control for the state of the local business cycle.

Results in Table 2 are robust to including a time trend (that controls for trends in the dependent variable) and to having the lagged dependent variable on the right-hand side (not shown). Since right-hand side variables are lagged one period, autocorrelation in local-currency convenience yields can bias their coefficients. Inclusion of the lagged-dependent variable controls for endogeneity that may arise from the persistence of the dependent variable. Since the data are at the monthly frequency and span more than ten years, adding the lagged dependent variable is unlikely to give rise to the Nickell (1981) bias.

3 A Model of Safe Havens and Convenience Yields

I consider a four-period ($t = t_0, t_1, t_2, t_3$) environment. There are entrepreneurs who run firms that issue safe debt (e.g., corporate bonds), in mass F. Firms may have liquidity needs, as explained below. Asset trading occurs in a secondary market with endogenous trading frictions, as in Duffie, Garleanu, and Pedersen (2005). At t_0, the government also issues a quantity B of risk-free government-backed securities. I assume that both government and private bonds have no default risk, and each has a price $P_{0,j}$ at t_0, for $j \in \{B, F\}$. The bonds are real, denominated in units of the consumption good. I do not consider foreign consumption goods to better resemble the empirical Section, where currency risk was accounted for. Finally, there is a continuum of homogeneous risk-neutral investors that buy the debt of firms and governments.

Each entrepreneur owns a firm that can issue debt to invest in a project at t_0. The project will generate profits of one, of which χ are received in t_1 and the rest, $1-\chi$, are received at a stochastic time, either t_2 or t_3. The investment has a cost of β^2, which is incurred at t_0. At t_0, the entrepreneur can raise funds for the investment by selling debt with a face value of one maturing at t_2, which will be repaid using the future profits. For simplicity, the model is set up so that borrowing and investment are always profitable for the entrepreneur.

The problem of a given entrepreneur i is to maximize:

$$u_i^F = c_0 + \beta c_1 + \beta^2 c_2 + \beta^3 c_3, \quad c_t \geq 0, \quad \beta < 1 \tag{11}$$

where c_t is consumption and β the discount factor.

There is a mass I of investors with sufficiently large endowments to purchase bonds issued by the government and firms at t_0. The investors are risk-neutral with preferences

$$u_i^I = c_0 + \beta c_1 + \beta^2 c_2 + \beta^3 c_3, \quad c_t \geq 0, \quad \beta < 1 \tag{12}$$

Each investor potentially owns one bond, and bonds are indivisible. The total mass of bonds is $B+F$. Define the total mass of bondholders to be $m_I = B + F \leq I$. That is, there are enough investors to purchase all of the bonds at t_0.

3.1 Liquidity Shock and Firm Decisions

The liquidity need in the model arises if the entrepreneur's profits arrive late at t_3 while his debt is due at t_2. In this case, his debt and profits streams are mismatched in time, and the firm will face a liquidity shortage. With the possibility of late revenues, the firm will want to trade its future revenues for bonds in t_1 because such an asset would allow it to have a savings vehicle to extinguish its t_2 debt obligations. The financial assets that firms seek are the bonds issued by the government, B, and by other firms, F, at date t_0. If there are more bonds available, this trade will be less frictional.

The probability of receiving profits late is ϕ, which is realized at t_2. Furthermore, the probability ϕ is subject to an aggregate shock. The state is $\omega \in \{L, H\}$ (for Low or High liquidity shock), and in state ω, which has probability q^ω, the late profit realization probability ϕ takes on the value ϕ_ω. I assume that $\phi_L < \phi_H$. The state realization is a shock to aggregate liquidity: if the realized value of ϕ is higher (ϕ_H), more firms experience timing mismatch and, therefore, there is less supply of liquidity at t_2.

At t_1, secondary markets open, and firms can purchase a bond for settlement at t_2. There are gains from trade in a meeting. Since investors discount the future at rate $\beta < 1$, an investor who owns a bond is willing to sell the bond as long as he receives at least a quantity β of goods that he consumes at t_1. The gains from trade in a match between investor and firm is therefore $\chi - \beta$. I assume the firm receives a fraction η of this surplus, and the investor keeps the remaining $1 - \eta$ share. I assume there is no trading in state-contingent financial claims in t_1 nor ex-post trading among firms in t_2, which would be further impeded by the aggregate liquidity shortage.

At t_1, the following matching function defines the number of meetings between liquidity demanders (firms) and liquidity suppliers (date t_0 investors) for each bond $j \in \{B, F\}$:

$$n_j = \lambda m_{j,F}^{\theta} m_{j,I}^{\theta}, \quad \frac{1}{2} < \theta < 1 \tag{13}$$

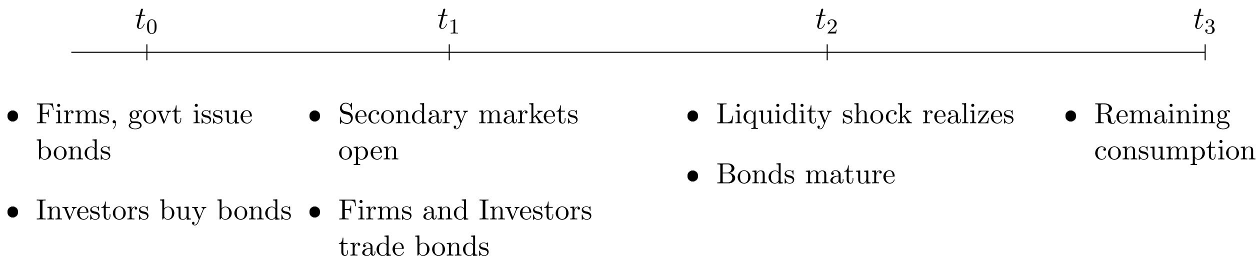
Here, $\lambda > 0$ captures the overall degree of liquidity of the money market, and $m_{j,F}$ is the mass of firms purchasing bond type j (defined below). This is an over-the-counter bond market, as in Duffie, Garleanu, and Pedersen (2005), where firms trade goods with investors for their one-period bonds. However, I abstract from taking a stand on the market structure of this trade.

The key property of this matching function is increasing returns to scale, corresponding to $\theta > 1/2$. If the masses of both firms and bond-holding investors double, the number of matches more than doubles. Thus, the search model embeds a thick-market liquidity externality as in Diamond (1982).

Given the matching function, the endogenous two-sided meeting probabilities are:

$$\alpha_{j,F} = \frac{n_j}{m_{j,F}^{\theta}} = \lambda m_{j,F}^{\theta-1} m_{j,I}^{\theta}, \qquad \alpha_{j,I} = \frac{n_j}{m_{j,I}^{\theta}} = \lambda m_{j,F}^{\theta} m_{j,I}^{\theta-1} \tag{14}$$

Figure 3: Timeline of the Model



Notes: The Figure shows a schematic representation of the model's events.

The first, $\alpha_{j,F}$, is the probability of a firm meeting a bond j seller (date t_0 investor in bonds) at time t_1. The second, $\alpha_{j,I}$, captures the probability that the bond seller meets a firm demanding bond j. The key economic force that the model captures is that the trade to obtain assets for settlement is frictional and that a greater outstanding quantity of bonds makes obtaining this liquidity easier.

If the firm does not trade with an investor, then it keeps its χ profits earned in t_1 and enters t_2 without a bond. If hit by the shock, it will not receive the remaining $1-\chi$ profits and will find itself without the liquidity to pay back its debt. I assume that in this bad state, the firm i can pay a disutility cost of $(1-\chi)\kappa_i > 0$ to make up the lost revenue. I assume that there is heterogeneity in the cost κ_i across firms and define $K_i \equiv \mathbb{E}[(1-\chi)\phi_\omega \kappa_i]$ as the expected private cost of making up for the lost revenue. Assume that K_i is distributed on $[\underline{K}, \infty]$ with cumulative distribution function $H(K_i)$ and density $h(K_i)$. This disutility cost is a modeling device to ensure firms face some costs due to lack of liquidity while also avoiding the need for debt haircuts and default risk.

Figure 3 provides a schematic timeline of the main events of the model.

The entrepreneur makes an issuance decision at date t_0. Denote D_i as an indicator that takes the value one if the firm issues debt to invest and zero if the firm does not. The firm decides at date t_1 to trade for a bond or not. Denote T_i as an indicator function that reflects the decision to trade. Then, the entrepreneur's problem is:

$$\max_{D_i,T_i} \mathbb{E}[c_0 + \beta c_1 + \beta^2 c_2 + \beta^3 c_3] \tag{15}$$

Consumption at date t_0 is $c_0 = D_i(P_{0,F} - \beta^2)$ and thus the firm invests, $D_i = 1$, as long as $P_{0,F} \geq \beta^2$. At t_1, the firm decides if it purchases a bond or not. It compares its expected utility of doing so with the expected utility of entering t_2 without a bond. For simplicity, I assume that at t_2, if the firm receives its $(1-\chi)$ profits, it delays its consumption until t_3. This way, consumption at t_2 will always be zero, and at t_3 will always be $(1-\chi)$, regardless of the shock realization. Therefore, the decision at t_1 to buy a bond or not depends exclusively on the consumption at t_1. Thus, the firm purchases a bond if at t_1 the following holds:

$$\beta[\alpha_{j,F}\eta(\chi-\beta)] > \beta[\chi - K_i] \tag{16}$$

On the left-hand side, the utility of purchasing a bond corresponds to the probability of finding an investor times the share of the gains from trade. On the right-hand side, the utility of not trading is decreasing in the expected cost of making up the lost revenue if the bad shock occurs in t_2.

Denote as $\overline{K}$ the threshold cost above which firms choose to purchase the bond. All firms with $K_i > \overline{K}$ will find it optimal to purchase a bond in t_1. Therefore, the mass of liquidity-demanding firms is

$$m_F = F(1 - H(\overline{K})) \tag{17}$$

Of this mass of liquidity-demanders, $m_{B,F}$ will demand the government bond, and a mass of $m_{F,F}$ will demand the other firms' bonds. I leave this decision unmodeled, and below, I analyze what happens with the convenience yield (derived below) when firms decide to buy one bond or the other. Therefore, this is not a model of the endogenous determination of a safe haven. Rather, it only characterizes the dynamics of the convenience yield given the safe haven status.

Below, I impose the following restrictions:

Assumption 1. *The parameters obey $\chi \geq \beta$ and $\phi_L = 0$*

These parameters make the model simpler to analyze. $\chi \geq \beta$ rules out the case where there are losses from trade between firms and investors in t_1. $\phi_L = 0$ makes the High realization of the shock the only bad realization where there is a shortage of aggregate liquidity.

3.2 Asset Market Equilibrium and Risk Dynamics

I solve for $P_{0,j}$ backwards. Consider the market at date t_1 first. If a match occurs, the total surplus is $\chi - \beta$, of which a bond seller obtains $(1-\eta)(\chi-\beta)$. I assume that the date t_0 bond market is Walrasian. Each investor can bid for exactly one bond at date t_0. If an investor purchases a bond at t_0, the investor either resells the bond at date t_1 to earn $\beta + (1-\eta)(\chi-\beta)$, or the investor holds the bond to maturity. Thus, the investor's valuation of the bond at t_0 is:

$$P_{0,j} = \mathbb{E}[\alpha_{j,I}\beta][\beta + (1-\eta)(\chi-\beta)] + (1-\mathbb{E}[\alpha_{j,I}])\beta^2 \tag{18}$$

where the first term is the expected probability of finding a match in t_1 times the present value of the sale. The second term is the expected probability of not being matched times the present value of 1 (the face value of the bond). The expression can be rewritten as:

$$P_{0,j} = \beta^2 + \mathbb{E}[\alpha_{j,I}]\beta(1-\eta)(\chi-\beta) \tag{19}$$

The wedge $P_{0,j} - \beta^2$ corresponds to the convenience yield of the bonds issued at t_0. Consider the pricing of a completely illiquid bond, which in the model is one for which $\mathbb{E}[\alpha_{j,I}] = 0$. This bond will be priced at β^2. The government and private firm bonds in the model are priced at $P_{0,j} > \beta^2$ because they offer settlement liquidity to firms at date t_1. The convenience yield increases in the expected match probability, $\mathbb{E}[\alpha_{j,I}]$, and the surplus gained from the match, $(1-\eta)(\chi-\beta)$.

The effect of risk can be captured in the model as a comparative static at t_0 across q. At t_2, a value of ϕ_ω will be realized to be either ϕ_L or ϕ_H. The ϕ_H is an event of liquidity shortages. At t_1, firms know that such an event may transpire and cannot meet their obligations.

Recall that I left the decision of which bond to purchase unmodeled. Firms at t_1 could purchase either the government bond of other firms' bonds, with masses $m_{B,F}$ and $m_{F,F}$, respectively, and with $m_{B,F} + m_{F,F} = m_F$. In this regard, I define a safe haven as follows:

Definition 1. *Bond j ($j \in \{B, F\}$) is a safe haven if firms decide to purchase it at t_1 to protect themselves against a rise in the risk of a bad outcome (liquidity shortages in t_2).*

Proposition 4. *If an asset is considered a safe haven, then its safety/liquidity value (measured by the convenience yield) increases with risk (it shows a positive covariance). In terms of the model, if bond j is a safe haven, then its convenience yield, $P_{0,j} - \beta^2$, is increasing in the ex-ante risk of liquidity shortages, q.*

Proof: see the Appendix.

It is helpful to provide the intuition of the proof. An increase in q increases the expected disutility cost of facing liquidity shortages without a bond. This increase is proportional for all firms in the K_i distribution. However, since the threshold $\overline{K}$ does not change, this means that more firms will choose to buy bonds in t_1. From the investors' perspective, this increases the probability of finding a buyer at t_1, increasing the convenience yield.

Importantly, Proposition 4 can be tested empirically by estimating the convenience yield's response to different risk factors. The response will be positive for assets that firms consider a safe haven against the corresponding risk (they purchase the asset when the risk increases) and negative otherwise. This is analyzed in the next Section.

3.3 Discussion of Model Assumptions

1. The model is not about the endogenous determination of a safe haven. Rather, it characterizes the response of the convenience yield to an increase in risk, taking the safe haven status as given. The endogenous evolution of the safe haven status has already been addressed in other papers, for example, He, Krishnamurthy, and Milbradt (2019) and Brunnermeier, Merkel, and Sannikov (2024).

2. Notice that the liquidity shock does not affect the firm's solvency, so there is no need for debt haircuts in the model. I focused on liquidity risk rather than credit risk to better match the empirical Section, where I estimated the convenience yields after controlling for default risk.

4 Sovereign Bonds as Safe Havens

4.1 Global and Local Factors

In this Section, I present evidence on the role of local-currency sovereign bonds in EME as safe havens. I test Proposition 4 by estimating the response of the convenience yield against global and country-specific risk factors. In particular, an asset is a safe haven against global risk if its safety/liquidity value (measured by the convenience yield) increases with the global risk factor. Similarly, an asset is a safe haven against local or country-specific risk if its safety/liquidity value (measured by the convenience yield) increases with the local risk factor.

Assume a decomposition of the convenience yields into a global and a local factor:

$$CY_t^j = \rho_t^{US} + \rho_t^{EM} \tag{20}$$

for $j \in \{d, f\}$. The global factor, ρ_t^{US}, captures risk sentiment of investors on the global economy (Rey, 2013; Miranda-Agrippino and Rey, 2022). This can also relate to financial frictions on intermediaries that limit thier arbitrage (Gabaix and Maggiori, 2015; Morelli, Ottonello, and Perez, 2022). The local factor, ρ_t^{EM}, captures country-specific frictions that can arise from economic policy uncertainty affecting investors. The local factor shapes the risk sentiment of investors towards a given country.

To capture global risk sentiment, I employ the VIX as in Rey (2013) and Miranda-Agrippino and Rey (2022), who document that the VIX strongly correlates with a global factor that explains about a quarter of the variance in risky asset prices and about 35% of the variance in gross capital flows.

To capture local risk sentiment, I employ the Economic Policy Uncertainty (EPU) index by Baker, Bloom, and Davies (2016). The index is available for Brazil, Chile, Colombia, and Mexico. To complement and as a robustness check, I also employ the risk index from the International Country Risk Guide (ICRG) dataset, which provides data on a country's political, economic, and financial risks for more than 140 countries at a monthly frequency.

The EPU index is built using monthly counts of articles in local newspapers that convey the extent of uncertainty. In the case of the indices for Brazil, Chile, Colombia, and Mexico, the keywords an article must contain to be considered in the index are "uncertainty" and "economy/economic"[5]. The issue with this index is that authors also include words related to international policies, such as "dollar", "federal reserve", etc. In this sense, this index might have strong collinearity with the VIX and thus lead to misleading results.

The ICRG gives a score for each source of risk in a country. I will include the financial and economic risk variables, each of which has five components, and their assessments are made solely on the basis of objective data. Economic risk includes GDP per capita, real GDP growth, inflation rate, budget balance over GDP, and current account over GDP. Financial risk includes foreign debt to GDP, foreign debt service over exports of goods and services, current account over exports of goods and services, net international liquidity as months of import cover, and exchange rate stability.

Among these two risk variables, I consider economic risk to better capture local risk factors. Financial risk, as is the case with the EPU index, captures variables that are strongly linked to foreign policy, and thus can be strongly linked to the VIX.

I take Equation (20) to the data, which can be estimated in a linear regression as follows:

$$cy_{i,t} = \gamma_1 \log(VIX_{t-1}) + \gamma_2 \log(EPU/ICRG_{i,t-1}) + c_i + \epsilon_{i,t} \tag{21}$$

where, as in Section 3.1, i is currency/country, t is month, $cy_{i,t}$ is the convenience yields, and the independent variables are lagged one month. The regression also includes country fixed effects, and standard errors are double-clustered across month and country. The risk variables from the ICRG are standardized by the mean and standard deviation of each country (higher values reflect higher risk).

Table 3 shows the results for the dollar convenience yield. Columns 1-3 include the global risk factor along with each of the three versions of the local risk factors. While the dollar convenience yield responds positively with local risk, the response is strongly negative against global risk.

[5] After obtaining a raw count, the number of articles is scaled by the total number of articles in the same newspaper and month. Then, they standardize each newspaper's scaled frequency counts to have a unit standard deviation within a period of time (usually starting in the mid-1990s or early 2000s). Finally, they normalize the series to have a mean of 100 over the same period

Table 3: Dollar Convenience Yield and Risk Factors

Dep. var.: dollar CY	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VIX_{t-1}	-1.734***	-2.258***	-2.691***	-1.295***	-1.650***	-1.397***	-1.609***
	(0.281)	(0.241)	(0.228)	(0.292)	(0.282)	(0.272)	(0.267)
EPU_{t-1}	26.34***						
	(3.471)						
Economic $risk_{t-1}$		16.20***		14.30***		12.28***	
		(2.143)		(1.794)		(1.719)	
Financial $risk_{t-1}$			20.46***		19.77***		16.25***
			(2.046)		(1.679)		(1.942)
Country FE	Y	Y	Y	Y	Y	Y	Y
MP rate & Debt supply	N	N	N	Y	Y	Y	Y
K Inflows & ToT	N	N	N	N	N	Y	Y
Observations	563	1,012	1,012	1,012	1,012	1,012	1,012
R-squared	0.367	0.437	0.449	0.503	0.518	0.548	0.551

Notes: Data are at monthly frequency. Standard errors are double-clustered by country and month. Start dates vary among countries but end in March 2021 for all. Capital inflows-to-GDP variables are standardized by the mean and standard deviation of each country. *** p<0.01, ** p<0.05, * p<0.1

Notably, this suggests that, compared to a foreign asset, the local currency sovereign bond is a safe haven against local or idiosyncratic risk. At the same time, it does not work as a safe haven against global uncertainty.

Columns 4 and 5 control for the responses of the monetary policy rate and the supply of government debt. This shows that results are not driven by the responses of the central bank and the fiscal authority, who could alter the supply of safe and liquid assets in response to varying uncertainty.

Finally, Columns 6 and 7 add capital inflows and the terms of trade as explanatory variables. Capital inflows over GDP work as a robustness check for the effect of global risk sentiment because it can capture the effect of financial constraints of global intermediaries (Gabaix and Maggiori, 2015), which would also be captured by the VIX. In addition, the VIX strongly correlates with gross capital flows. If the coefficient of the VIX index remains significant after controlling for capital inflows, this would confirm that global uncertainty has a negative effect on its own. I added capital inflows disaggregated by the sector they

Table 4: Domestic Convenience Yield and Risk Factors

Dep. var.: dom. CY	(1)	(2)	(3)	(4)
VIX_{t-1}	0.947***	0.909***	1.268***	0.886**
	(0.305)	(0.306)	(0.432)	(0.408)
Economic risk_{t-1}	8.617***		11.74***	
	(2.134)		(2.831)	
Financial risk_{t-1}		2.402		1.095
		(1.756)		(2.210)
Country FE	Y	Y	Y	Y
Year FE	N	N	Y	Y
MP rate & Debt supply	Y	Y	Y	Y
Observations	806	806	806	806
R-squared	0.546	0.535	0.578	0.565

Notes: Data are at monthly frequency. Standard errors are double-clustered by country and month. Start dates vary among countries but end in March 2021 for all. *** p<0.01, ** p<0.05, * p<0.1

are directed to (government, bank, or corporate debt), using data from Adjiev et al. (2022). The terms of trade control for a global factor highly correlated with commodity indices and international trade, explaining 31% of the variance of fluctuations in private liquidity worldwide (Miranda-Agrippino and Rey, 2022).

Table 4 shows the results for the domestic convenience yield. Since the domestic convenience yield is estimated as a raw spread between to assets, without adjusting for credit risk, I include controls for all regressions.

In stark contrast with the dollar convenience yield, the domestic convenience yield correlates positively with the global risk factor. This suggests that, compared to priavte domestic assets, the local currency sovereign bond does work as a safe asset for both types of risks.

Combined, Tables 3 and 4 suggest that the safe asset status of local currency sovereign bonds in EMEs is dependent on the nature of the shock and the benchmark asset.

If we take both measures of the convenience yield as coming from the two "types" of investors defined in Section 2, then these results have important implications for the investor base in EMEs. While domestic investors do consider the local currency sovereign bond as a safe asset for local and global risk, foreign investors only do so for local shocks. This can add an extra source of volatility during episodes of global uncertainty.

In addition, these results imply that the commonly held view that capital inflows are only determined by yield-oriented foreign investors is strongly dependent on the nature of the shock.

4.2 Analysis of Two Exogenous Shocks

This subsection tries to better understand the reason why the dollar convenience yield drops against higher global uncertainty. I do this by analyzing the response to two identifiable exogenous shocks to EMEs: the Taper Tantrum and the Covid pandemic. These are widely accepted as exogenous and unanticipated adverse shocks to EMEs. The Taper Tantrum started with Fed Chairman Ben Bernanke's speech in May 2013, which signaled the end of the Fed's large-scale asset purchases and, thus, a future reduction in the supply of dollar liquidity. The Covid-19 episode likely represents many shocks; therefore, I will focus my analysis on the early months of the pandemic (March-June 2020). Both episodes involved increased risk and a capital inflow reversal for EMEs. Still, one difference is that, unlike the first months of the Covid shock, the Taper Tantrum did not trigger a flight to safety episode (understood as global investors buying U.S. Treasuries because of their safety). This can be seen in the response of the VIX index (which did not increase).

I run a regression with the dollar-investor convenience yield on the left-hand side and interact the shocks with the explanatory variables of the previous sections. The interacted coefficients capture any change in the sensitivity of convenience yields to the different determinants and will shed light on which variables most likely drive the responses during these episodes. Results show that the response of the dollar convenience yield is quite different in the two episodes, driven in each case by different explanatory variables. Compared to Table **??**, I introduce the supply of debt as the relative supply of U.S. Treasuries over local debt, which allows for a less noisy estimation of the supply coefficient.

Table 5 shows the results. Column 1 shows that the Taper Tantrum had a positive and significant effect. In Column 2, the coefficient of the interaction between the shock and the local monetary policy rate is positive and statistically significant. This variable proxies for the price of money and near-money assets. As explained before, a higher monetary policy rate is associated with a higher price of liquidity. The positive sign of the interaction term suggests that the convenience yield increased due to the demand for liquidity during the episode. Recall that during the Taper Tantrum, there was no flight to safety but scarcer liquidity that plausibly drove up the convenience yield of sovereign bonds. As Column 2 shows, this effect is not driven by the rise in risk premia, as captured by the slope of the local yield curve.

In contrast, Column 3 shows that the Covid shock significantly reduced the local-currency convenience yield by almost 19 basis points. In Column 4 the interaction of the shock with the relative supply of U.S. Treasuries is significantly negative, suggesting the slope of the demand for this global safe asset became significantly steeper. This is consistent with a global flight to the safety of U.S. Treasuries and with global investors preferring this safe asset over the local sovereign bond.

Column 4 suggests that what drives the drop in convenience yield (or the loss of safety status) is not the rise in credit risk or risk premia charged by global investors during this type of episode but a switch in preferences towards other sources of safety/liquidity. This provides further evidence that demand for safety is a relevant driver of capital flows, not only for advanced economies but also for emerging economies.

4.3 Summary of Empirical Analysis

Let me briefly summarize the key takeaways from this and the previous section. Data on deviations of covered interest parity conditions and local asset spreads show investors are willing to pay a safety/liquidity premium on EMEs' local-currency sovereign bonds. However, this does not make them equivalent to a U.S. Treasury or an advanced economy. The responses of the convenience yield against global and local risk factors suggest that their safe asset status is dependent on the nature of the shock and the benchmark asset. The response of the dollar convenience yield against global risk suggests that their value as safe assets drops for foreign investors during episodes of increased global uncertainty measured by the VIX index. A comparison between the Taper Tantrum and the Covid shock suggests

Table 5: Effect of Taper Tantrum and Covid-19 Shocks

Dep. var: $cy_{i,t}$	(1)	(2)	(3)	(4)
Non-interacted regressors	Yes	Yes	Yes	Yes
TT_{t-1}	4.875***	2.972		
	(1.348)	(2.778)		
MP $\text{rate}_{t-1} \times \text{TT}$		2.030***		
		(0.524)		
$\log(\frac{\text{US debt to GDP}}{\text{Local Debt to GDP}})_{t-1} \times \text{TT}$		0.682*		
		(0.366)		
$\text{vix}_{t-1} \times \text{TT}$		-0.783**		
		(0.379)		
$\text{slope}_{local,t-1} \times \text{TT}$		0.413		
		(1.551)		
Covid-19_{t-1}			-18.92***	-21.84***
			(5.908)	(5.517)
MP $\text{rate}_{t-1} \times$ Covid-19				-1.830
				(1.513)
$\log(\frac{\text{US debt to GDP}}{\text{Debt to GDP}})_{t-1} \times$ Covid-19				-2.358***
				(0.601)
$\text{vix}_{t-1} \times$ Covid-19				0.570*
				(0.288)
$\text{slope}_{local,t-1} \times$ Covid-19				3.108
				(1.930)
Constant	46.92**	49.41***	47.11**	51.79**
	(18.32)	(18.55)	(18.60)	(19.70)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Lagged dep. var.	Yes	Yes	Yes	Yes
Observations	1,091	1,091	1,091	1,091
R-squared	0.838	0.839	0.841	0.846

Notes: See Table **??**. *TT* is a dummy variable taking the value one from May to December 2013. Covid-19 is a dummy variable taking the value one from March to June 2020. All columns include country and year fixed effects *** p<0.01, ** p<0.05, * p<0.1

that the reason is not driven by higher credit risk or a higher risk premium, but by loss of safety status based on investors' preferences.

In the Internet Appendix, I run regressions but with credit risk (measured as the differential CDS spread) as a dependent variable, which is another CIP deviation component. If my decomposition in Section 2 accurately disentangled local-currency bond premiums from default risk, then the determinants should differ. The results of that exercise confirm this. Contrastingly with convenience yields, credit risk does not respond to the supply of debt.

5 Discussion

5.1 Sources of Convenience Yields

Where do these convenience yields come from? There are a number of models that can give a rationale. For example, local currency sovereign debt can be a source of liquidity for local banks in the domestic credit market when financial frictions prevent the banking sector from satisfying its demand for liquidity with privately issued securities (Perez, 2018). For example, in a setting where banks face heterogeneous investment opportunities, those banks facing lower productivity projects might find it preferable to invest in public debt instead.

There are models that could also explain the drop in the dollar convenience yields against higher global uncertainty. From the perspective of international lending, global financial intermediaries are lenders to EME sovereigns. A negative aggregate shock can lower financial intermediaries' net worth, contract the supply of funds, and increase the cost of external finance due to collateral constraints (Morelli, Ottonello, and Perez, 2022). In this context, an "inconvenience" premium could arise in holding EME sovereign bonds if the constraints make these bonds more expensive.

In the same line, Devereux, Engel, and Wu (2023) and Mendoza and Quadrini (2023) present full quantitative models of the world economy where sovereign bonds earn a convenience yield from their use as collateral when borrowing abroad is constrained. In these models, U.S. Treasuries play a special role in the world economy and earn a convenience yield against negative global shocks because they have better collateral quality than other assets. However, in these models, the collateral quality is not microfounded. One could extend these models to allow sovereign bonds of other countries to also earn a convenience yield, maybe against local shocks. In addition, a drop in EME convenience yields could occur if they lose a safe asset status when global investors coordinate around U.S. Treasuries as the only source of safety against a global shock.

Another source of convenience yields is the interaction between search frictions and credit risk in secondary markets for sovereign bonds of EMEs. In Chaumont (2021), the higher the default probability, the lower the incentives for investors to purchase bonds and the smaller the mass of investors that show up in the secondary markets as buyers, reducing liquidity. Moreover, as the probability of default increases, investors holding bonds have higher incentives to find a counterpart to sell the bonds. According to Passadore and Xu (2022), search frictions in the secondary market introduce liquidity risk that affects prices in the primary market, which, in turn, affects debt and default policies. At the same time, because investors foresee worse liquidity conditions should a default occur, current liquidity conditions also deteriorate, which increases liquidity risk. In these settings, if an EME sovereign significantly improves its credit ratings and the depth of the domestic financial markets over the years, one could get lower liquidity and credit risks that justify a convenience yield by some investors.

Finally, convenience yields can arise because of liquidity regulations. In the U.S. and other countries, financial market regulators give government bonds a special role as an asset to comply with liquidity ratios in the banking sector, or they assign a lower weight to government bonds when assessing the capital needs of banks. Chari, Dovis, and Kehoe (2020) show that, without commitment, this is optimal when the government needs to issue unusually large amounts of debt. In addition, these regulations increase credibility because when banks hold government debt, defaults dilute net worth and are, therefore, more costly.

5.2 Demand for EME Sovereign Bonds

How do these convenience yields relate to recent findings on demand estimation for EME sovereign bonds and the role of heterogeneous investors?

Fang, Hardy, and Lewis (2022) analyze investor demand for sovereign debt using a demand system approach based on low-frequency country-level data of sovereign debt ownership split by banks and non-banks, both foreign and domestic. They find that most of the new debt issuance is absorbed by private non-banks, and they are the creditor group most responsive to the yield. Zhou (2024) focuses on a more detailed foreign investor split:

investment funds prone to risk-sensitive redemption and banks, insurers, and pension funds with a more stable demand structure. He finds that foreign insurers and pension funds tilt their emerging market portfolio towards securities with higher credit quality, and their sensitivity to the shifts in the VIX index is lower than for foreign investment funds. Moreover, during the Taper Tantrum and the Covid pandemic, foreign banks, insurers, and pension funds responded by buying EME sovereign debt, while investment funds became net sellers. In the same line, Converse, Levy-Yeyati, and Williams (2023) show that exchange-traded funds (ETFs) amplify EMEs' sensitivity to the global financial cycle.

According to these findings, it is plausible to think that foreign insurers and pension funds could be driving the dollar convenience yield estimated in Section 2.1.2. Their demand structure is more stable, they are less sensitive to global risk factors, they have a downward-sloping demand curve for EME sovereign debt, and they do not face the strong redemption pressure investment funds face during episodes of heightened global uncertainty.

Moretti et al. (2024) present evidence of downward-sloping demand curves for risky sovereign bonds. Their paper features a structural model with a demand structure that includes both active and passive investors. The equilibrium bond price includes a function that captures the demand's downward-sloping nature and which they identify with a "convenience yield". However, by construction, this function decreases the bond price, so they assume an "inconvenience yield". While their notion of "convenience yields" refers to anything that makes demand inelastic, the approach by Krishnamurthy and Vissing-Jorgensen (2012) and Du, Im, and Schreger (2018) can be seen as a price-based way to link a spread between assets to a demand for safety and liquidity more specifically.

Moretti et al. (2024) observe lower default risk and higher bond prices in the presence of an inelastic demand compared to a scenario with an elastic demand because the former works as a commitment device. With a downward-sloping demand, issuing an additional unit of debt decreases bond prices even if default risk remains fixed. As a result, the government finds issuing large amounts of debt too costly, and thus, an inelastic demand limits the amount of debt the government is willing to issue. They point out that this result is not driven by investors' preferences for holding the debt (which could be related to "convenience yields"), but that is in part due to them only allowing for "inconvenience yields".

6 Conclusion

This paper shows that convenience yields due to safety/liquidity services are relevant in pricing local-currency sovereign bonds in EMEs. I use these convenience yields to assess the role of these bonds as safe assets. They are a safe haven compared to domestic private assets against both local and global risk. However, they are a safe haven compared to foreign private assets only against local risk. Evidence from the Taper Tantrum and the Covid episodes suggest that the explanation does not rest on higher credit risk or risk premia, as it would be expected, but on losing the safe asset status due to a switch in preferences towards U.S. Treasuries. This provides further evidence that demand for safety is a relevant driver of capital flows for advanced economies and emerging economies.

The dynamics of convenience yields and their response to global shocks have important implications for EMEs that call for more research on this topic. For example, losing the safe asset status could lead to a higher interest rate volatility that can have an impact on the fiscal capacity of EMEs' governments. Additionally, convenience yields are one reason for bond demand to be downward sloping, allowing large-scale asset purchases (LSAPs) by EMEs´ central banks to have an impact on yields. Indeed, many EME central banks conducted such purchases during the Covid crisis. Therefore, if the convenience yield from global investors drops during a crisis, that will limit the effectiveness of LSAPs.

Finally, given the relevance of the demand for safety, more research is needed to explain the cross-sectional differences in convenience yields among different types of countries (primary surpluses, low inflation risk, regulations, etc.). In addition, future research can aim to understand better how policies common to EMEs interact with convenience yields, such as reserve accumulation, different forms of capital controls, or foreign exchange intervention.

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Appendix A Proofs of Propositions 1-3 (Section 2)

Proof of Proposition 1. This proof is similar to the one in Krishnamurthy and Vissing-Jorgensen (2012). Denote the domestic price level at date t as Q_t. If the investor buys a zero-coupon nominal domestic sovereign bond for a price P_t^T, her real holdings θ_t^T rise by P_t^T/Q_t. The first order condition for this bond holdings is, then,

$$-\frac{P_t^T}{Q_t}u'(C_t) + \beta E_t\left[\frac{P_{t+1}^T}{Q_{t+1}}u'(C_{t+1})\right] + \frac{P_t^T}{Q_t}v'(\theta_t^d/\mathrm{GDP}_t^d)u'(C_t) = 0 \tag{22}$$

Define the pricing kernel for nominal payoffs as

$$M_{t+1} = \beta\frac{u'(C_{t+1})}{u'(C_t)}\frac{Q_t}{Q_{t+1}} \tag{23}$$

so that, in the absence of default risk, we would have:

$$P_t^T = E_t[M_{t+1}P_{t+1}^T\Lambda_t^{T,d}] \tag{24}$$

where $\Lambda_t^{T,d} \equiv 1/(1-v'(\theta_t^d/\mathrm{GDP}_t^d))$ captures the marginal benefits investor d derives from these local-currency sovereign bonds of the EME. A positive marginal value of convenience, $v'(\cdot)$, raises $\Lambda_t^{T,d}$, and therefore raises the price of the bond, P_t^T.

Suppose that the EME sovereign can default next period with probability π_t^T, and L_{t+1}^T measures the amount of losses suffered in default (a random variable). If the bond does not default, it is worth P_{t+1}^T. Then, its price satisfies,

$$P_t^T = \pi_t^T E_t[M_{t+1}\Lambda_t^{T,d}(1-L_{t+1}^T)|\text{Default}] + (1-\pi_t^T)E_t[M_{t+1}P_{t+1}^T\Lambda_t^{T,d}|\text{No Default}] \tag{25}$$

For simplicity, assume continuously compounded yields and consider the case of one-period bonds (so $P_{t+1}^T = 1$). Define $\tilde{L}_{t+1}^T$ as a random variable that is equal to zero if there is no default and equal to L_{t+1}^T if there is a default. Then, the expression for the price of the bond is

$$\begin{aligned} e^{-y_t^T} = P_t^T &= E_t[M_{t+1}\Lambda_t^{T,d}] - E_t[M_{t+1}]E_t[\tilde{L}_{t+1}^T] - \mathrm{cov}_t[M_{t+1},\tilde{L}_{t+1}^T] - \mathrm{cov}_t[\Lambda_t^{T,d},\tilde{L}_{t+1}^T] \\ &\approx e^{\lambda_t^{T,d}-\pi_t^T(E_t[L_{t+1}^T]+\mathrm{cov}_t[M_{t+1},\tilde{L}_{t+1}^T]/E_t[M_{t+1}])-\mathrm{cov}_t[\lambda_t^{T,d},\tilde{L}_{t+1}^T]/E_t[M_{t+1}]}E_t[M_{t+1}] \end{aligned} \tag{26}$$

where $\lambda_t^{T,d} \approx v'(\theta_t^d/\mathrm{GDP}_t^d)$ and $\mathrm{cov}_t[M_{t+1},\tilde{L}_{t+1}^T]/E_t[M_{t+1}]$ is a risk premium if default events coincide with bad states. Take logs on both sides to get :

$$y_t^T \approx y_t^{rf} - \lambda_t^{T,d} + l_t^T - \xi_t^{T,d} \tag{27}$$

where $y_t^{rf} = -\log M_{t+1}$ (no arbitrage condition); $l_t^T = \pi_t^T(E_t[L_{t+1}^T] + \text{cov}_t[M_{t+1}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}])$ denotes the compensation for default (expected losses plus premium); $\lambda_t^{T,d}$ is the convenience yield (how much the total yield is reduced because of the marginal services provided by the bond); and $\xi_t^{T,d} = \text{cov}_t[\lambda_t^{T,d}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}]$ denotes the covariance between default risk and the convenience yield.

The decomposition of the yield of the private asset follows the same logic,

$$y_t^P \approx y_t^{rf} - \lambda_t^{P,d} + l_t^P - \xi_t^{P,d} \tag{28}$$

Take the spread between the two yields of the same maturity to get:

$$y_t^P - y_t^T \approx (\lambda_t^{T,d} - \lambda_t^{P,d}) + (l_t^p - l_t^j) + (\xi_t^{T,d} - \xi_t^{P,d}) \tag{29}$$

□

Proof of Proposition 2. Denote the US price level at date t as $Q_t^\$$. If the investor buys a zero-coupon nominal non-Treasury safe U.S. bond for a dollar price P_t^{US}, her real holdings θ_t^{US} rise by $P_t^{US}/Q_t^\$$. The first order condition for this bond holdings is then

$$-\frac{P_t^{US}}{Q_t^\$}u'(C_t) + \beta E_t\left[\frac{P_{t+1}^{US}}{Q_{t+1}^\$}u'(C_{t+1})\right] + \frac{P_t^{US}}{Q_t^\$}v'(\theta_t^f/\text{GDP}_t^f)u'(C_t) = 0 \tag{30}$$

Define the pricing kernel for nominal payoffs as

$$M_{t+1} = \beta\frac{u'(C_{t+1})}{u'(C_t)}\frac{Q_t^\$}{Q_{t+1}^\$} \tag{31}$$

so that, in the absence of default risk, we would have:

$$\begin{aligned} P_t^{US} &= E_t[M_{t+1}P_{t+1}^{US}] + P_t^{US}v'(\theta_t^f/\text{GDP}_t^f) \Rightarrow \\ P_t^{US} &= E_t[M_{t+1}P_{t+1}^{US}\Lambda_t^{US,f}] \end{aligned} \tag{32}$$

where $\Lambda_t^{US,f} \equiv 1/(1 - v'(\theta_t^f/\text{GDP}_t^f))$ captures the marginal benefits investor f derives from these non-Treasury safe bonds. A positive marginal value of convenience, $v'(\cdot)$, raises $\Lambda_t^{US,f}$, and therefore raises the price of the bond, P_t^{US}.

To add default risk, suppose that the issuer may default next period with probability π_t and, in default, pays $1 - L_{t+1}^{US}$, where L_{t+1}^{US} measures the amount of losses suffered in default (and is a random variable). If the bond does not default, it is worth P^{US}_{t+1}. Then, its price satisfies,

$$P^{US}_t = \pi_t E_t[M_{t+1}\Lambda^{US,f}_t(1-L^{US}_{t+1})|\text{Default}] + (1-\pi_t)E_t[M_{t+1}P^{US}_{t+1}\Lambda^{US,f}_t|\text{No Default}] \quad (33)$$

For simplicity, assume continuously compounded yields and consider the case of one-period bonds (so $P^{US}_{t+1}=1$). Define $\tilde{L}^{US}_{t+1}$ as a random variable that is equal to zero if there is no default and equal to L^{US}_{t+1} if there is a default. Then, the expression for the price of the bond is

$$\begin{aligned} e^{-y^{US}_t} = P^{US}_t &= E_t[M_{t+1}\Lambda^{US,f}_t] - E_t[M_{t+1}]E_t[\tilde{L}^{US}_{t+1}] - \text{cov}_t[M_{t+1},\tilde{L}^{US}_{t+1}] - \text{cov}_t[\Lambda^{US,f}_t,\tilde{L}^{US}_{t+1}] \\ &\approx e^{\lambda^{US,f}_t - \pi_t(E_t[L^{US}_{t+1}]+\text{cov}_t[M_{t+1},\tilde{L}^{US}_{t+1}]/E_t[M_{t+1}]) - \text{cov}_t[\lambda^{US,f}_t,\tilde{L}^{US}_{t+1}]/E_t[M_{t+1}]}E_t[M_{t+1}] \end{aligned} \quad (34)$$

where $\lambda^{US,f}_t \approx v'(\theta^f_t/\text{GDP}^f_t)$ and $\text{cov}_t[M_{t+1},\tilde{L}^{US}_{t+1}]/E_t[M_{t+1}]$ is a risk premium if default events coincide with bad states. Take logs on both sides to get :

$$y^{US}_t \approx y^{US}_{rf,t} - \lambda^{US,f}_t + l^{US}_t - \xi^{US,f}_t \quad (35)$$

where $y^{US}_{rf,t} = -\log M_{t+1}$ (no arbitrage condition); $l^{US}_t = \pi_t(E_t[L^{US}_{t+1}]+\text{cov}_t[M_{t+1},\tilde{L}^{US}_{t+1}]/E_t[M_{t+1}])$ denotes the compensation for default (expected losses plus premium); $\lambda^{US,f}_t$ is the convenience yield (how much the total yield is reduced because of the marginal services provided by the bond); and $\xi^{US,f}_t = \text{cov}_t[\lambda^{US,f}_t,\tilde{L}^{US}_{t+1}]/E_t[M_{t+1}]$ denotes the covariance between default risk and the convenience yield. □

Again, denote the price level at date t as $Q^{\$}_t$. Let the price of the EME sovereign bond be P^T_t. If the investor purchases one unit, her real holdings θ^T_t rise by $P^T_t/Q^{\$}_t \times 1/S_t$, where S_t is the nominal exchange rate. The first order condition for holdings of the synthetic bond is

$$-\frac{P^T_t}{Q^{\$}_t}\frac{1}{S_t}u'(C_t) + \beta E_t\left[\frac{P^T_{t+1}}{Q^{\$}_{t+1}}\frac{1}{F_{t+1}}u'(C_{t+1})\right] + \frac{P^T_t}{Q^{\$}_t}\frac{1}{S_t}v'(\theta^f_t/\text{GDP}^f_t)u'(C_t) = 0 \quad (36)$$

As before, for simplicity, assume one-period bonds, so $P^T_{t+1}=1$ and the forward rate is a one-period ahead rate, $F_{t+1}=F^1_t$. In the absence of other risks, we would have:

$$\begin{aligned} P^T_t\frac{F^1_t}{S_t} &= E_t[M_{t+1}] + P^T_t\frac{F^1_t}{S_t}v'(\theta^f_t/\text{GDP}^f_t) \Rightarrow \\ P^T_t\frac{F^1_t}{S_t} &= E_t[M_{t+1}\Lambda^{T,f}_t] \end{aligned} \quad (37)$$

where $\Lambda_t^{T,f} \equiv 1/(1-v'(\theta_t^f/\text{GDP}_t^f))$ captures the marginal benefits investor f derives from the bond issued by the EME sovereign.

Recall that the EME sovereign can default next period with probability π_t^T, and L_{t+1}^T measures the amount of losses suffered in default (a random variable). The synthetic bond faces an additional loss upon default. If the sovereign defaults, the currency hedging becomes imperfect, and the investor f loses L_{t+1}^T and still needs to unwind the swap position with unmatched local EME currency cash flows. Regarding positively correlated default and currency risk, the local currency depreciates more upon default than the non-default state. The investor f holding the synthetic bond has a net long position in dollars in the event of default, corresponding to additional currency gains. As a consequence, in the default state, the bond pays $[1 - L_{t+1}^T + L_{t+1}^T(1 - F_{t+1}/S_{t+1})]$.

Du and Schreger (2016) show that the pricing impact of the foreign exchange hedging error, $L_{t+1}^T(1 - F_{t+1}/S_{t+1})$, is precisely equal to $\frac{\text{cov}_t(1-L_t^T,1/S_{t+1})}{E_t(1-L_{t+1}^T)E_t(1/S_{t+1})}$. I will denote this term q_t^T and refer to it as the covariance between default and currency risks.

Analogously, assume that the EME sovereign can enact regulations on local-currency assets with probability $\tilde{\pi}_t^T$ (for example, capital controls or currency convertibility restrictions), and this event imposes a loss of K_{t+1} on the investor (a random variable). This loss will also produce a hedging error in the swap position of the investor, as in the case of default losses. Equivalently, define the bond payoff in the event of capital controls as $[1 - K_{t+1} + K_{t+1}(1 - F_{t+1}/S_{t+1})]$. The hedging error term will be exactly equal to $\frac{\text{cov}_t(1-K_t,1/S_{t+1})}{E_t(1-K_{t+1})E_t(1/S_{t+1})}$, term which I will denote as p_t and refer to it as the covariance between capital control risk and currency risk.

In the end, the losses in the event of default and regulations impositions are $L_{t+1}^T - q_t^T$ and $K_{t+1} - p_t$, respectively. Define $\tilde{L}_{t+1}^T$ as a random variable that is equal to zero if there is no default and equal to $L_{t+1}^T - q_t^T$ if there is a default. Equivalently, define $\tilde{K}_{t+1}$ as a random variable that is equal to zero if capital controls are not imposed and equal to $K_{t+1} - p_t$ if they are set. Then, the expression for the price of the synthetic bond is

$$
\begin{aligned}
e^{-y_t^T+\rho_t} = P_t^T \frac{F_{t+1}}{S_t} &= E_t[M_{t+1}\Lambda_t^{T,f}] - E_t[M_{t+1}]E_t[\tilde{L}_{t+1}^T] - E_t[M_{t+1}]E_t[\tilde{K}_{t+1}] \\
&- \text{cov}_t[M_{t+1}, \tilde{L}_{t+1}^T] - \text{cov}_t[M_{t+1}, \tilde{K}_{t+1}] - \text{cov}_t[\Lambda_t^{T,f}, \tilde{L}_{t+1}^T] - \text{cov}_t[\Lambda_t^{T,f}, \tilde{K}_{t+1}] \\
&\approx e^{\lambda_t^{T,f} - \pi_t^T(E_t[L_{t+1}^T] + \text{cov}_t[M_{t+1}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}]) + q_t^T - \tilde{\pi}_t^T(E_t[K_{t+1}] + \text{cov}_t[M_{t+1}, \tilde{K}_{t+1}]/E_t[M_{t+1}])} \\
&\times e^{p_t - \text{cov}_t[\Lambda_t^{T,f}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}] - \text{cov}_t[\Lambda_t^{T,f}, \tilde{K}_{t+1}]/E_t[M_{t+1}]} \times E_t[M_{t+1}]
\end{aligned}
\tag{38}
$$

Taking logs on both sides gives:

$$
y_t^T - \rho_t \approx y_{rf,t}^{US} - \lambda_t^{T,f} + (l_t^T - q_t^T) + (k_t - p_t) - \xi_t^{T,f} - \psi_t^{T,f} \tag{39}
$$

where $y_{rf,t}^{US} = -\text{log}M_{t+1}$; $\lambda_t^{T,f} \approx v'(\theta_t^f/\text{GDP}_t^f)$ is the convenience yield on the local-currency bond; $l_t^T = \pi_t^T(E_t[L_{t+1}^T] + \text{cov}_t[M_{t+1}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}])$ and $k_t = \tilde{\pi}_t^T(E_t[K_{t+1}] + \text{cov}_t[M_{t+1}, \tilde{K}_{t+1}]/E_t[M_{t+1}])$ are the extra yield demanded for default and regulatory losses; and $\xi_t^{T,f} = \text{cov}_t[\Lambda_t^{T,f}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}]$ and $\psi_t^{T,f} = \text{cov}_t[\Lambda_t^{T,f}, \tilde{K}_{t+1}]/E_t[M_{t+1}]$ are the covariances of the convenience yield with default risk and regulatory risk, respectively. □

Proof of Proposition 3. Following the same reasoning as in the two previous proofs, the price of an EME sovereign bond issued offshore in dollars, $\hat{P}_t^T$, is given by:

$$
\hat{P}_t^T = E_t[M_{t+1}\hat{P}_{t+1}^T]\hat{\Lambda}_t^{T,f} \tag{40}
$$

Assume the local government can default on this bond with probability $\hat{\pi}_t^T$, imposing a loss of $\hat{L}_{t+1}^T$ on the investor. In this case, $\tilde{L}_{t+1}^T$ is a random variable taking the value $\hat{L}_{t+1}^T$ in the case of default and zero otherwise. However, since the bond is issued in dollars and offshore, the government cannot impose capital controls or currency convertibility restrictions. Therefore, assuming again one-period bonds and continuous compounding, the price is given by

$$
\begin{aligned}
e^{-\hat{y}_t^T} = \hat{P}_t^T &= E_t[M_{t+1}\hat{\Lambda}_t^{T,f}] - E_t[M_{t+1}]E_t[\tilde{L}_{t+1}^T] - \text{cov}_t[M_{t+1}, \tilde{L}_{t+1}^T] - \text{cov}_t[\hat{\Lambda}_t^{T,f}, \tilde{L}_{t+1}^T] \\
&\approx e^{\hat{\lambda}_t^{T,f} - \hat{\pi}_t^T(E_t[\hat{L}_{t+1}^T] + \text{cov}_t[M_{t+1}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}]) - \text{cov}_t[\hat{\lambda}_t^{T,f}, \tilde{L}_{t+1}^T]/E_t[M_{t+1}]} E_t[M_{t+1}]
\end{aligned}
\tag{41}
$$

Taking logs on both sides gives:

$$
\hat{y}_t^T \approx y_{rf,t}^{US} - \hat{\lambda}_t^{T,f} + \hat{l}_t^T \tag{42}
$$

where variables have the same interpretation as in the previous two proofs. Now, define Φ_t^{FC} as the spread between the yield of the synthetic bond (Equation (39)) and the yield on the foreign currency-denominated bond (Equation (42)). Then,

$$\begin{aligned}\Phi_t^{FC} \equiv & y_t^T - \rho_t - \hat{y}_t^T \\ & \approx (y_{rf,t}^{US} - \lambda_t^{T,f} + (l_t^T - q_t^T) + (k_t - p_t) - \xi_t^{T,f} - \psi_t^{T,f}) - (y_{rf,t}^{US} - \hat{\lambda}_t^{T,f} + \hat{l}_t^T) \\ & = (\hat{\lambda}_t^{T,f} - \lambda_t^{T,f}) + (l_t^T - \hat{l}_t^T - q_t^T) + (k_t - p_t) - \xi_t^{T,f} - \psi_t^{T,f}\end{aligned} \tag{43}$$

□

Appendix B Proof of Proposition 4 (Section 3)

Notice that, since $K_i \equiv \mathbb{E}[(1-\chi)\phi_\omega \kappa_i]$, a higher q increases $\mathbb{E}[\phi_\omega]$ and this produces a proportional increase on all the K_i distribution. In addition, notice that the value of $\overline{K}$ is not affected since none of the other terms in Equation (16) depends on q. Therefore, the effect of a higher q can be analyzed in a similar way as the effect of a drop in $\overline{K}$.

Take logs on the expression for the convenience yield and get:

$$\log(P_{0,j} - \beta^2) = \log \lambda + \theta \log m_{j,F} + (\theta - 1) \log m_{j,I} + constant \tag{44}$$

Since $H(\overline{K})$ is monotonically increasing in $\overline{K}$, the derivative of the convenience yield with respect to H has the same sign as with respect to $\overline{K}$:

$$\begin{aligned}\frac{\partial \log(P_{0,j} - \beta^2)}{\partial H} &= \frac{\partial \log m_{j,F}}{\partial H} \\ &= -\frac{F}{m_{j,F}} < 0\end{aligned} \tag{45}$$

Therefore, an effective drop of $\overline{K}$ increases the convenience yield. Intuitively, an increase in q increases the expected cost of disutility for all firms. Since the threshold has not changed, this means that more firms will choose to buy bonds in t_1. From the investors' perspective, this increases the probability of finding a buyer in t_1, increasing the convenience yield. □

Appendix C Data Sources

Recall from the main text the expression for the dollar-investor convenience yield:

$$\lambda_t^{T,f} - \lambda_t^{US,f} = y_t^{US} - (y_t^{T} - \rho_t) + (l_t^{T} - l_t^{US}) + \Phi_t^{FC} - \tau_t + (\xi_t^{US,f} - \xi_t^{FC,f}) \tag{46}$$

The sources for each component are the following:

Bond yields and forward premia. I used data from the Resolution Funding Corporation (Refcorp) bonds for various maturities for yields of non-Treasury-safe dollar bonds. As suggested by Longstaff (2004), Refcorp bonds are effectively guaranteed by the U.S. government and are subject to the same taxation, but are not as liquid as Treasuries. As in Longstaff (2004), I measured the yields by taking the differences between the constant maturity on the Bloomberg Fair Value curves for Refcorp zero-coupon bonds. Maturities available are 6-month, 1-, 2-, 3-, 4-, 5-, 7-, 10-, and 20-year. For robustness, I also used the yields for Aaa corporate bonds, which Krishnamurthy and Vissing-Jorgensen (2012) argued have very low default rates but are not as liquid as Treasuries. Data on these corporate bond spreads are available in FRED but only provide a 20-year maturity benchmark. All these sources also include data on yields for U.S. treasuries, which I use in Appendix D.

The other two yields for non-Treasury safe dollar bonds correspond to the ICE Bank of America AAA and BBB US Corporate Index. These track the performance of US dollar-denominated corporate debt issued in the US domestic market, with AAA and BBB credit ratings, respectively. They include all maturities greater than one year. The series were retrieved from FRED, Federal Reserve Bank of St. Louis.

The value of the forward premium for each country was taken from the database of Du et al. (2018). The authors provide estimations of CIP deviations of sovereign bonds for ten developed and 18 developing countries to U.S. Treasuries. The data are at a daily frequency between approximately 2000 and March 9, 2021, although the start date varied among countries. Data are available for maturities at 3-months, 1-, 2-, 3-, 5- and 10-years.

I focused on their observations of developing countries. Their bond yields data came from Bloomberg and Thomson Reuters. Since forward contracts are, in general, not very liquid, they computed $\rho_{i,t}$ from a hedging strategy involving interest rate swaps and cross-currency swaps, according to the formula $\rho_{i,n,t} = irs_{i,n,t} + bs_{i,n,t} - irs_{US,n,t}$. $irs_{i,n,t}$ is the n-year interest rate swap for exchanging fixed currency i cash flows into the floating interbank rate benchmark in country i. $bs_{i,n,t}$ is the n-year cross-currency basis swap rate for exchanging the floating benchmark interbank rate in country i for the U.S. Libor rate, and $irs_{US,n,t}$ is the n-year U.S. Libor swap rate for exchanging fixed dollar cash flows into the U.S. Libor rate. The combination of these three swaps eliminates all floating cash flows. At the inception and maturity of the swap, only fixed cash flows remain between local currency and U.S. dollars, which exactly replicates an n-term forward contract.

Default risk differentials ($l_t^{US} - l_t^T$). I proxied $l_{i,t}$ with data on CDS spreads. I obtained the CDS spread series for EMEs' sovereign bonds of different maturities from Bloomberg at a daily frequency. However, some caveats apply. First, I used the CDS spreads for foreign-currency debt, as their data are more widely available and show greater liquidity than local-currency CDS. Therefore, I assumed that the risk of default on foreign-currency debt also applies to local-currency bonds. As discussed in Du and Schreger (2016), this assumption is not much different from reality as default events in EMEs since the late 1990s show that the incidence of default on domestic-currency debt is comparable with the incidence of external foreign-currency defaults.

Spread between swapped local-currency bond and foreign-currency bond (Φ_t^{FC}). I used the data from Du and Schreger (2016). For y_t^{FC}, I used the Bloomberg Fair Value curves (BFV) for the prices of foreign-currency sovereign bonds for each EME. These are at par yield curves, so they must be adjusted to represent zero-coupon yields. BFV prices are not available for some of the countries. In those cases, I estimated prices by collecting data for each bond and computing the overall zero-coupon yield curve using the methodology of Nelson and Siegel (1987).

Liquidity risk of forwards contracts (τ_t). τ_t is measured as half the bid-ask spread of each cross-currency swap. Daily data is available on Bloomberg. For Brazil, Colombia, Indonesia, Peru, Philippines, and Turkey, the cross-currency swap is the non-deliverable swap between the fixed local rate and the floating U.S. Libor. For Chile, Mexico, and South Africa, it corresponds to the bid-ask spread of the interest rate swap used to construct the cross-currency swap in Du and Schreger (2016).

Domestic convenience yield The yield on the 1-year local-currency sovereign bond comes from the dataset in Du et al. (2018). The private local-currency domestic assets used for each country are listed in Table 6. All yields are for the 1-year maturity except for Mexico, where only the 9-month maturity was available.

Table 6: Private local-currency domestic assets

Country	Asset	Bloomberg ticker
Chile	Nominal average interbank rate 360 days	CLTN360N
Colombia	Time deposits of banks yield curve	COMM1YR
Indonesia	Unsecured interbank loan	JIIN12M
Mexico	Certificate of Deposits 9 month	MPDRI
South Africa	Interbank agreed rate 12 month	JIBA12M
Turkey	Interbank unsecured loan	TRLXB1Y

Internet Appendix

A. Robustness for estimation of Section 2.1.2

I describe some financial frictions and prominent features in the markets for EMEs' local-currency government bonds. I address how these issues may affect my estimate of the local-currency convenience yield and propose some robustness checks when applicable.

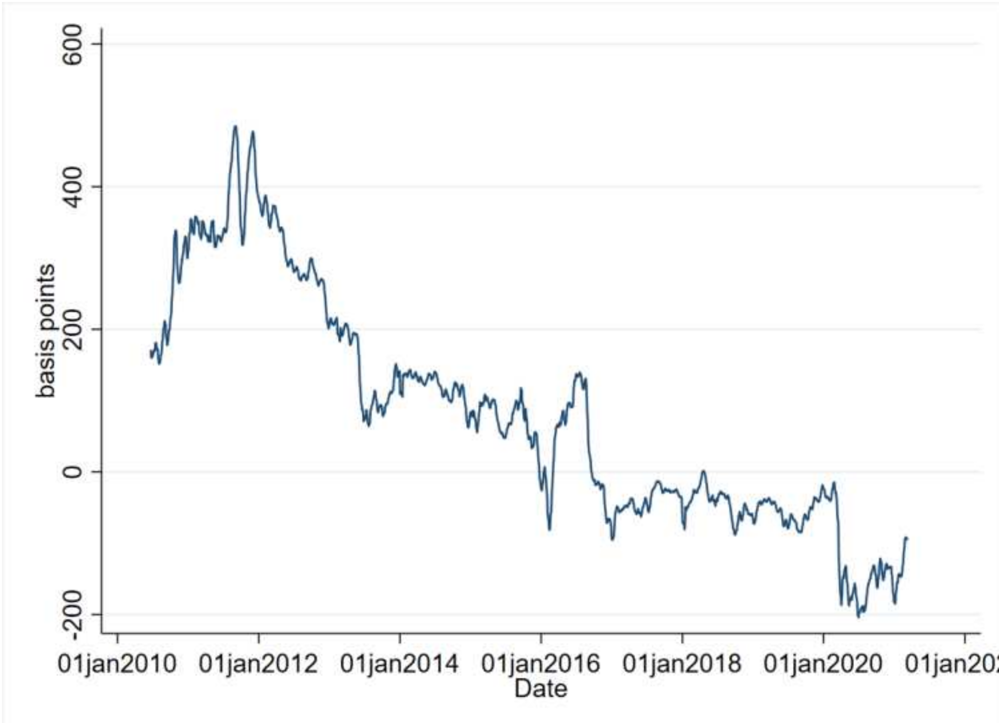
A.1. The role of regulatory risk

As explained in the main text, local-currency bonds in EMEs carry the risk of the local government imposing capital controls, taxes on outflows, or currency convertibility restrictions. The term $\Phi_t^{FC,i}$ in Equation (9) intends to account for the risk by taking the spread between sovereign bonds issued under international vs. domestic law. The former does not give as much regulatory freedom to the EME government; therefore, this spread should account for most of these regulatory risks.

In this subsection, I want to provide an idea of how relevant this adjustment is by using the example of Brazil. Figure 4 plots the time series of $\Phi_t^{FC,i}$ for the period 2010-2021.

Recall from Equation (8) that this spread will be larger: (1) the larger the domestic regulatory risk (k_t^j), and (2) the lower the covariance between default and regulatory risk and currency risk (q_t^j and p_t^j). The spread is positive and large at the beginning of the sample. Importantly, this period coincides with the Brazilian government's imposition of capital outflow taxes. In October 2009, the government introduced a tax on financial transactions (the IOF) of 2% on foreign investment in fixed-income instruments. In 2010, the tax was raised to 4 and then to 6%, and stayed at that level until it was abandoned in June 2013. Consistent with this timing, the spread $\Phi_t^{FC,i}$ moved around 200-500 basis points. A negative value of this spread (relevant after 2016) means that the positive covariance of currency risk with other risks is more significant than the risk of capital controls and other regulations.

Figure 4: Local vs. Foreign jurisdiction spread for Brazil



Notes: The Figure shows the spread between the swapped local-currency sovereign bond and the foreign-currency-denominated bond.

A.2. Eurobonds

Eurobonds are securities denominated in a different currency than the local one of the country where the bond is being issued (despite their name, they are not necessarily bonds issued in Europe or in euros). EME sovereigns frequently issue Eurobonds, which usually correspond to sovereign bonds issued in international markets in the EME's local currency.

Importantly, these bonds are governed under international law, settled in U.S. dollars, and therefore free of capital control, convertibility restrictions, and other regulatory risks imposed by the EME government. Equation (9) in Section 2.1 measures the convenience yield for local-currency bonds issued under *domestic* law, and that is the reason it corrects for the risk of capital controls and other regulatory risks imposed by the local government. However, this correction is unsuitable for Eurobonds, and Equation (9) overstates the magnitude of the local-currency convenience yield if a country issues most of its local-currency debt via Eurobonds.

Although I don't have a precise breakdown of Eurobonds on the total local currency sovereign debt outstanding, I use the International Debt Securities (IDS) database from the Bank of International Settlements to get an estimate of the prevalence of Eurobonds in local-currency sovereign debt in EMEs. The IDS reports the outstanding government bonds issued in international markets in local currency. Although it doesn't distinguish between foreign and domestic law, it still serves as a proxy for the amount of local currency bonds governed by foreign law.

Table 7 shows the percentage of outstanding local currency government bonds issued in international markets according to IDS over the total amount of outstanding local currency bonds issued in all markets. Data is available for only 5 of the nine countries in my sample.

Table 7: Share of total LC-bonds outstanding issued in international markets

Country	Mean	Max
Brazil	0.5%	0.9% (Dec. 2007)
Chile	2.4%	4.8% (Dec. 2021)
Colombia	3.6%	6.1% (Dec. 2007)
Peru	35.4%	47.5% (Dec. 2019)
Philippines	3.3%	4.3% (Dec. 2021)

Notes: annual frequency for 2004-2021. Share calculated with outstanding values at the end of each year. Column 3 shows the year in which the maximum share was achieved.

Overall, only Peru has a significant amount of outstanding local-currency bonds issued in international markets as a proportion of total local-currency debt. Brazil has less than 1% of the total, while Chile, Colombia, and the Philippines move around only 3% of the whole. Even if all these local-currency bonds are governed by foreign law, that still would represent a minimal percentage with the only exception of Peru. However, Peru has no capital controls on foreign investments during the period considered.

A.3. Market segmentation

Another potential issue with Equation (9) in Section 2.1 would be that the market for EME sovereign bonds is segmented. Here, I consider two possible segmentation dimensions: foreign vs. local investors and local-currency bonds issued under international vs. domestic law.

Regarding the first dimension, if local investors are the only holders of local-currency sovereign bonds while foreign investors only hold sovereign bonds denominated in foreign currency, the spread in Equation (9) would be misleading. The reason is that the two bonds would have two different marginal investors.

Recently published data by the BIS shows that this is not the case for sovereign bonds in EMEs in general and for the countries in my sample in particular (Onen et al., 2023). This database provides a breakdown of government bonds (with maturity over one year), currency denomination, and foreign/local investor ownership. In Table 8, I report two statistics for the nine countries in my sample. Column 1 shows the average share of all local-currency government bonds that foreign investors own. Column 2 shows the percentage of local-currency bonds in foreign investors' portfolios. Both averages are calculated from 2005 to 2021 at the quarterly frequency.

Table 8 shows no signs of market segmentation in local-currency bonds. Foreigners own a sizable share of these bonds, representing a significant share of their portfolio of EMEs. This is especially clear in the case of Brazil and Chile, where, although foreigners own less than ten percent of local currency bonds, they still are a relevant component of foreigners' investment in these countries. The time series (not captured in this table) shows an upward trend until the mid-2010s, with a drop afterward for most countries. Moreover, this share is also sizable when taken over the overall portfolio of foreign investors.

A second dimension of market segmentation can arise between local-currency bonds issued under international and domestic law. In this case, it might be that all the share of local-currency government bonds owned by foreigners correspond to bonds governed by international law (Eurobonds), while local investors own only the bonds issued under domestic law. Again, evidence does not show this to be the case. Onen et al. (2023) show that most of the increase in foreign ownership of local-currency sovereign bonds in the past two decades

Table 8: Share of total LC-bonds owned by foreigners

Country	$\frac{\text{LC owned by foreigners}}{\text{Total LC bonds}}$	$\frac{\text{LC owned by foreigners}}{\text{Total foreigners portfolio}}$
Brazil	8%	65%
Chile	9%	29%
Colombia	16%	36%
Indonesia	27%	49%
Mexico	24%	51%
Peru	40%	36%
South Africa	27%	71%
Turkey	16%	42%

Notes: quarterly frequency for 2005-2021. Data comes from the BIS (Onen et al., 2023) and only considers bonds with one year or more maturity.

has come from foreigners increasingly participating in the *domestic* market.

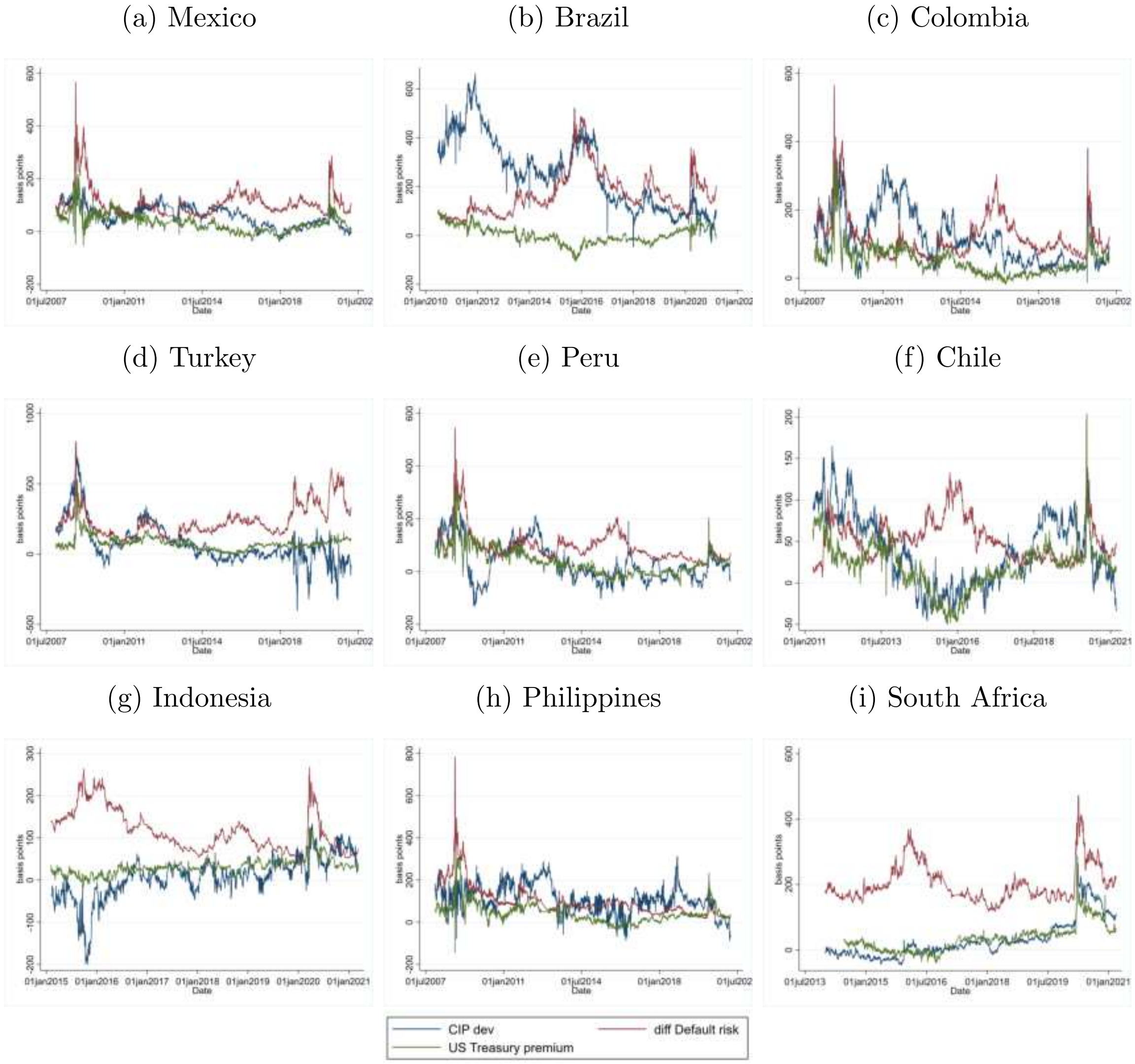
B. Analysis of the U.S. Treasury Premium

In this Section, I replicate the analysis of the dollar convenience yield, but with the U.S. Treasuries as the benchmark asset instead of the non-Treasury safe assets. This exercise resembles the one for G10 countries shown in Du, Im, and Schreger (2018).

In this case, $y_t^T - \rho_t - y_t^{US}$ corresponds to the CIP deviation between the two sovereign bonds (notice that now I am subtracting the U.S. yield from the swapped EME bond). The term $\lambda_t^{US,f} - \lambda_t^{T,f}$ corresponds to the U.S. Treasury premium (how much investors pay for the safety/liquidity of U.S. Treasuries against EME local-currency bonds). $\lambda_t^{US,f}$ is proxied by the spread between the U.S. agency bond and the U.S. Treasury, and $\lambda_t^{T,f}$ by the dollar convenience yield estimated in Section 2.1.2.

Figure 5 compares the evolution of CIP deviations and two components: differential default risk and the U.S. Treasury premium. CIP deviations spiked during crises (i.e., in 2008

Figure 5: CIP Deviation and Components, 5-Year Local-Currency Sovereign Bonds



(a) Mexico (b) Brazil (c) Colombia

(d) Turkey (e) Peru (f) Chile

(g) Indonesia (h) Philippines (i) South Africa

and 2020), which was driven by an increase in differential default risk and the U.S. Treasury premium. The increase in the U.S. Treasury premium aligns with intuition: During financial distress, investors prefer the liquidity and safety of U.S. Treasuries. After 2008, the U.S. Treasury premium steadily declined until 2015-2016. This means that during this period, investors were willing to pay a lower premium for the safety and liquidity of U.S. government debt versus comparable debt of EMEs. This premium then increased again until the end of the sample.

These patterns starkly contrast with the G10 counterparts Du, Im, and Schreger (2018) estimated. In that paper, the authors showed that the U.S. Treasury premium for long maturities became consistently negative after 2010, meaning that investors were no longer willing to pay an extra price for the safety and liquidity of U.S. Treasuries compared to the sovereign bonds of the G10 countries. Based on this result, some authors have cast doubt on the safety status of long-term U.S. Treasuries. Figure 5 shows that this is not the case for EMEs. U.S. Treasuries are still considered a safe asset compared to their EME counterparts.

Surprisingly, CIP deviations outside of financial crises closely followed the U.S. Treasury premium dynamics -and not the dynamics of default risk- for Mexico, Colombia, Peru, Chile, Indonesia, and South Africa. In these countries, even though differential credit risk significantly increased in 2015-16, CIP deviations decreased, following the dynamics of the U.S. Treasury premium. This is surprising as research on EMEs has predominantly focused on the determinants of default risk, not convenience yields. One final note of caution is needed for Turkey in 2018-2019. The series for CIP deviations became very noisy and turned negative. These were years of severe capital outflows and recession in Turkey, and the negative values of the CIP deviation likely arose because of market segmentation, in which only local investors predominantly hold local-currency sovereign bonds.

The role of capital control risk (absent in Du, Im, and Schreger, 2018) can be seen in Figure 5 by the vertical distance between the CIP deviation (blue line) and the two components shown (red and green lines). This was accounted for by the sum of the capital control risk term plus the covariances term Equation (6). Two episodes in the data stand out: Brazil during 2010-2014 and Colombia soon after 2010. In the case of Brazil, the government imposed a tax on financial transactions in October 2009 to curb portfolio investment flows and cross-border derivative trading. Still, the tax was lifted in June 2013.

C. Robustness for Section 3

C.1. Credit risk as the dependent variable

Suppose my decomposition of CIP deviations in Section 2 successfully disentangled differential default risk from differential convenience yields. In that case, default risk should respond differently to the determinants of convenience yields analyzed in Section 3.

Table 9 replicates the regressions in Section 3 but with the CDS for each country and time as the dependent variable. The larger number of observations is because I had data for CDS spreads for a few more countries than I had convenience yield estimates. Unlike the EME local-currency convenience yield, credit risk is unaffected by the supply of government debt, suggesting that the convenience yield accurately captures the demand for safety and liquidity. The local monetary policy rate level increased credit risk since it likely increased the cost of servicing the debt. The VIX index also positively impacted credit risk, which is consistent with intuition. Interestingly, debt inflows to government debt significantly reduced credit risk, which is expected as foreigners' buying local debt increases the chance of repayment. The same happened with inflows into bank debt, which is consistent with sovereign debt being mostly held by banks in EMEs. Overall, this evidence suggests that the decomposition of CIP deviations in Section 2 accurately distinguished between credit risk and convenience yields.

Table 9: Determinants of Credit Risk (5-Year Sovereign Bond)

Dep. var: $cds_{i,t}$	(1)	(2)	(3)	(4)	(5)
MP rate$_{t-1}$	11.94***	11.48***	11.65***	11.70***	6.214***
	(1.410)	(1.377)	(1.404)	(1.413)	(1.924)
$\log(\frac{\text{US debt to GDP}}{\text{Debt to GDP}})_{t-1}$	-8.027	-4.336	-8.776	-9.849	-30.78**
	(16.09)	(14.86)	(16.37)	(16.47)	(12.11)
US fed funds$_{t-1}$	-14.66**	-11.31	-13.86*	-14.09*	-11.77
	(7.115)	(7.349)	(7.149)	(7.177)	(7.894)
vix$_{t-1}$	4.575***	4.352***	4.429***	4.339***	4.271***
	(0.420)	(0.456)	(0.421)	(0.442)	(0.520)
$(\frac{DebtInfl}{GDP})_{t-1}$		-26.84***			-21.75***
		(6.746)			(7.064)
$(\frac{EqtInfl}{GDP})_{t-1}$		-30.39*			-13.49
		(15.58)			(14.77)
$(\frac{GovdebtInfl}{GDP})_{t-1}$			-6.065*	-6.690**	
			(3.167)	(3.198)	
$(\frac{BankdebtInfl}{GDP})_{t-1}$			-8.105**	-7.921**	
			(3.154)	(3.151)	
$(\frac{CorpdebtInfl}{GDP})_{t-1}$			-3.961*	-3.982*	
			(2.142)	(2.121)	
Terms of Trade				-241.4	-196.4
				(189.7)	(165.3)
Diff. Inflation					8.440***
					(2.229)
Democratic risk					-1.152
					(7.117)
Constant	-1.286	-28.20	-7.972	1,110	1,058
	(88.08)	(86.53)	(91.53)	(875.5)	(746.5)
Observations	1,338	1,338	1,338	1,338	1,213
R-squared	0.689	0.702	0.698	0.700	0.734

Notes: see Table ??. All columns include country and year-fixed effects. *** p<0.01, ** p<0.05, * p<0.1