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Risk capacity, portfolio choice and exchange rates*

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Abstract

We assess how swings in exchange rates affect global bond investors' portfolio allocations to emerging market economy (EME) local currency bonds based on a portfolio choice model and empirical analyses using granular security-level bond spread data and fund-level bond flow data. We lay out a portfolio choice model in which swings in exchange rates can affect investors' risk-taking capacity in a Value-at-Risk framework. Exchange rate fluctuations induce shifts in portfolio holdings of global investors even in the absence of currency mismatches on the part of the borrowers and in particular when they are broadly common across EMEs rather than idiosyncratic. Empirical evidence from granular security-level bond spread and fund-level bond flow data supports the predictions of the model. An appreciation of an EME currency against the US dollar increases bond fund inflows and reduces bond spreads. The effect is considerably stronger when the appreciation is broad-based, as captured by the broad US dollar index, than when it is idiosyncratic.

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1 Introduction

In explaining fluctuations in financial markets, commentators are fond of invoking the "risk appetite" of investors and how the waxing and waning of their risk appetite is responsible for large swings in market outcomes. However, such talk sits uncomfortably with the orthodox economic practice of assuming that preferences are held fixed as part of the underlying fundamentals of the economy, not changing with the twists and turns of financial markets.

A more promising approach to making sense of "risk appetite" is to focus on the overall context of the investor's portfolio choice problem, including the underlying constraints under which the investor operates. The risk-taking capacity of investors can shift even in the absence of changes in economic fundamentals affecting the borrower. Taking this alternative approach to portfolio choice focuses attention on the determinants of the constraints faced by the investor in explaining swings in risk sentiment, rather than focusing exclusively on the creditworthiness of the borrower.

One particular context where sharp swings in risk sentiment have played an important role has been in portfolio investment in emerging market economies (EMEs). After the recurrent financial crises of the 1990s, EMEs focused their policy efforts on overcoming "original sin", a term coined by Barry Eichengreen and Ricardo Hausmann (1999) for the inability of developing countries to borrow from abroad in their domestic currency. A key element of the efforts has been the development and deepening of local currency sovereign bond markets which now enable EME sovereigns to routinely borrow in their local currency. However, owing to their small domestic institutional investor base, foreign portfolio investors play an important role in many of these markets (BIS (2019)). Since these investors typically measure their returns in US dollars or other advanced economy (AE) currencies, exchange rate movements amplify their gains and losses, thereby magnifying the risks they face in meeting obligations in their home currency.

In this sense, original sin has not disappeared, but rather has shifted elsewhere within the financial system. The currency mismatch is no longer borne by EME sovereign borrowers but has migrated to the foreign holders of the bonds. Exchange rate fluctuations will then still affect credit supply and borrower financial conditions if investors face balance sheet constraints. This is so, even when the borrower does not have any currency mismatch at all. Carstens and Shin (2019) coined the term "original sin redux" to refer to this enduring vulnerability of EMEs to exchange rate swings operating through fluctuations in the risk capacity and appetite of global investors. This vulnerability was also exposed during the Covid-19 induced sell-off in EME local currency bond markets in March 2020 and recently in the wake of the Ukraine war.

In this paper, we lay out a model of portfolio choice that captures the key features of original sin redux. The key element is a Value-at-Risk (VaR) constraint for a global investor who holds a diversified portfolio of assets in different currencies, but who evaluates gains and losses in dollar terms. A broad-based dollar depreciation then increases risk capacity of the investor through higher economic capital thereby relaxing the VaR constraint. One key prediction of the model is that a broad-based dollar depreciation has a larger impact on the local currency bond market of a particular EME than the equivalent percentage change in the bilateral dollar exchange rate.

Empirical evidence strongly supports the predictions of the model. We assess the link between risk capacity, portfolio choice and exchange rates based on a panel of EMEs using fund-level bond purchases and security-level bond spreads. We assess the impact of fluctuations in bilateral US dollar exchange rates and in the broad US dollar index using exchange rate shocks. We compute these shocks as the change in exchange rates on days of the European Central Bank's (ECB) or the Bank of Japan's (BOJ) monetary policy decisions which should be largely exogenous to events in the US and in EMEs. The use of such exchange rate shocks and of granular data on fund-level bond purchases and security-level bond spreads mitigates concerns over reverse causality which occur when country-level bond flows and aggregate bond spreads affect US dollar exchange rates. Our central finding is that an appreciation of the US dollar exchange rate is associated with a significant sale of EME local currency bonds and a widening of EME local currency sovereign bond spreads. Delving deeper, we find that the fluctuations in local currency yield spreads are mainly due to shifts in the credit risk premium measured by Du and Schreger (2016). This result points to the importance of risk capacity and portfolio adjustments in generating our results. Crucially, the relevant exchange rate for our findings is the broad US dollar index rather than the bilateral exchange rate of a country relative to the US dollar, in line with the predictions of the model.

Our analysis adds to the literature linking exchange rates and financial frictions. Gabaix and Maggiori (2015) provide a theory of the determination of exchange rates in imperfect financial markets. They show how capital flows drive exchange rates by altering the balance sheets of international financiers and thereby their ability to bear currency risk. Bruno and Shin (2015a, 2015b), on the other hand, show how credit risk and corporate borrowing in foreign currency introduce a role for the exchange rate in the determination of credit supply of global dollar financiers. In this paper, we develop a portfolio choice model which shows how exchange rate fluctuations affect investor demand for EME local currency bonds through global bond investors' VaR constraints.

Our paper also contributes to the accumulating empirical literature on the link between exchange rates and financial outcomes. Avdjiev et al. (2019a) and Engel and Wu (2018) explore the link between the exchange rate and the deviation from covered interest parity. In particular, Avdjiev et al. (2019a) emphasise the dollar exchange rate, while Engel and Wu (2018) show that other major currencies also exhibit similar properties. Hofmann et al. (2020) present evidence suggesting that an appreciation of an EME's local currency against the US dollar loosens financial conditions and has expansionary economic effects, while an appreciation of the EME's trade-weighted exchange rate has contractionary effects. This is consistent with the former working through financial channels and the latter through the standard trade channel. Bruno et al. (2022) show that EME stock returns also reflect the financial channel of exchange rates, with higher local currency stock returns associated with a weaker dollar. In their analysis, the broad dollar index emerges as a global factor, consistent with the financial channel operating through swings in risk-taking by global investors. Bertaut et al. (2023) use data on US investor flows to EMEs to show that dollar appreciation amplifies sell-offs in EME local currency bonds, but not in dollar-denominated bonds, possibly reflecting clientele effects of stickier investors toward the latter.

Our paper is further related to the literature modelling and analysing global spillovers to EMEs. The bulk of this literature focuses on traditional borrower currency mismatches which give rise to borrower balance sheet effects of exchange rate fluctuations (e.g. Basu et al. (2020), Adrian et al. (2020)). A number of recent papers have also emphasised the role of lender balance sheet frictions in the spirit of the original sin redux hypothesis. Hofmann et al. (2022) show, based on a two-country model, that borrowing from foreign investors in local currency (original sin redux) rather than foreign currency (original sin) reduces but does not eliminate EMEs' vulnerability to global financial shocks. Devereux and Wu (2022) find that FX reserve holdings can mitigate global financial spillovers by providing insurance to global investors against exchange rate volatility. This reduces the exchange rate risk premium in local currency spreads and facilitates larger local currency bond portfolios. Lee (2024) shows, based on a sovereign default model, that many EMEs still borrow in foreign currency and choose to bear exchange rate risk because international investors charge a high exchange rate risk premium on EME local currency debt. The risk premium is higher when exchange rate volatility increases, further dissuading EMEs from borrowing in local currency. Gilchrist et al. (2022) study the interplay between sovereign risk and global financial risk. They show that a substantial portion of the comovement among sovereign spreads is accounted for by changes in global financial risk measured through the VIX, a global financial risk factor or the excess bond premium. Our paper shows how changes in global financial conditions can affect global bond investors' credit supply through their balance sheet constraints and that broad based movements in the US dollar exchange rate matter more than bilateral ones.

Finally, our paper also contributes to the literature on the relationship between exchange rate fluctuations and macroeconomic outcomes. In the traditional Mundell-Fleming model, currency depreciation is expansionary as it boosts net exports. Krugman (1999) and Céspedes et al. (2004) examine models with corporate currency mismatches where currency depreciation is contractionary as it increases the value of collateral and hence relaxes borrowing constraints on EME corporates. Recent evidence suggests that there is a strong negative link between a broad-based appreciation of the dollar, reflected in an increase in the broad US dollar index, and macroeconomic outcomes in particular in EMEs (Avdjiev et al. (2019b), Shousha (2019), Hofmann and Park (2020)). Our analysis provides a conceptual and empirical basis for the attributes of the broad US dollar exchange rate as a barometer of global investor risk-taking capacity and of EME financial conditions.

The outline of our paper is as follows. In section 2, we develop a model of global investor portfolio choice in EME local currency bond markets, establishing the conceptual link between risk capacity, bond flows and exchange rates. Section 3 presents the data. In section 4, we conduct a systematic empirical investigation of the effect of exchange rate shocks on EME local currency bond market portfolio flows using monthly fund-level bond flow data. In section 5, we assess the price impact of exchange rate shocks on EME local currency bond markets using daily security-level data for sovereign spreads and credit risk premia. Section 6 concludes.

2 Model

We outline a model of global bond investors who hold a portfolio of emerging market local currency bonds. Denote by b_i the notional holding of bond i. The investor is risk-neutral and maximises expected return, but is subject to a Value-at-Risk (VaR) constraint of the form:

$$\alpha\sigma \leq \kappa \tag{1}$$

where α is a positive constant that captures the stringency of the VaR constraint, σ denotes the standard deviation of the return on the investor's portfolio and κ is the economic capital that is deployed by the investor. The constraint limits the size of the investor's portfolio so that α times the standard deviation of returns is bounded by κ. We allow κ to vary with the expected return of the portfolio.

The focus of our analysis is on how κ influences risk-taking. A high κ relaxes the VaR constraint, and allows the investor to take larger risks in the portfolio decision.

Denote by μ_i the expected return on bond i, and denote by μ the column vector of expected returns $\{\mu_i\}$. Notional bond holdings are given by the column vector b, and we denote by Σ the covariance matrix of returns.

$$\mu = \begin{bmatrix} \mu_1 \\ \vdots \\ \mu_n \end{bmatrix} \qquad b = \begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix} \qquad \text{and} \qquad \Sigma = \begin{bmatrix} \sigma_{11} & \cdots & \sigma_{1n} \\ & \ddots & \\ \sigma_{n1} & & \sigma_{nn} \end{bmatrix}. \tag{2}$$

where σ_{ij} is the covariance of returns between bond i and bond j.

The investor's portfolio choice problem is:

$$\underset{b}{\text{Maximise}}\ \mu' b \qquad \text{subject to} \qquad \alpha\sqrt{b'\Sigma b} \leq \kappa \tag{3}$$

where μ' is the transpose of μ and $\sqrt{b'\Sigma b}$ is the standard deviation of the return on the bond portfolio. We assume that economic capital κ is given by:

$$\kappa = c\,(\mu' b)^{\beta} \tag{4}$$

where c and β are positive constants such that $c \in (0,1)$ and $\beta \in \left(\frac{1}{2}, 1\right)$. A higher expected return provides a larger cushion to absorb shocks relative to the expected portfolio value. The assumption of $\beta \in \left(\frac{1}{2}, 1\right)$ captures the feature that economic capital is increasing at a diminishing rate as expected return increases, but economic capital rises at a rate close to that of expected returns itself.

The Lagrangian is

$$L = \mu' b - \lambda \left(\sqrt{b'\Sigma b} - \frac{c\left(\mu' b\right)^{\beta}}{\alpha} \right) \tag{5}$$

where λ is the Lagrange multiplier of the VaR constraint. The first-order condition with respect to b is

$$\begin{bmatrix} \mu_1 \\ \vdots \\ \mu_n \end{bmatrix} = \frac{\lambda}{2\sqrt{b'\Sigma b}} \begin{bmatrix} & \Sigma & \end{bmatrix} \begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix} - \frac{\lambda c}{\alpha} \beta \left(\mu' b\right)^{\beta - 1} \begin{bmatrix} \mu_1 \\ \vdots \\ \mu_n \end{bmatrix}. \tag{6}$$

Re-arranging, the optimal portfolio b satisfies:

$$b = \left(1 + \frac{\lambda c}{\alpha} \beta \left(\mu' b\right)^{\beta - 1} \right) \frac{1}{\lambda} \sqrt{b'\Sigma b} \cdot \Sigma^{-1} \mu. \tag{7}$$

Meanwhile, we can write the quadratic form $b'\Sigma b$ using (7) as:

$$\begin{aligned} b'\Sigma b &= \left(1 + \frac{\lambda c}{\alpha} \beta \left(\mu' b\right)^{\beta - 1} \right)^2 \frac{1}{\lambda^2} b'\Sigma b \cdot \mu' \Sigma^{-1} \Sigma \Sigma^{-1} \mu \\ &= \left(1 + \frac{\lambda c}{\alpha} \beta \left(\mu' b\right)^{\beta - 1} \right)^2 \frac{1}{\lambda^2} b'\Sigma b \cdot \mu' \Sigma^{-1} \mu. \end{aligned}$$

Dividing both sides by $b'\Sigma b$, we obtain:

$$1 = \left(1 + \frac{\lambda c}{\alpha} \beta \left(\mu' b\right)^{\beta - 1} \right)^2 \frac{1}{\lambda^2} \mu' \Sigma^{-1} \mu \tag{8}$$

which allows us to obtain the *generalised Sharpe ratio* $\sqrt{\mu'\Sigma^{-1}\mu}$. This is the n-dimensional analogue of the Sharpe ratio – the expected return normalised by the standard deviation of return. We thus have:

$$\frac{1}{\sqrt{\mu'\Sigma^{-1}\mu}} = \left(1 + \frac{\lambda c}{\alpha} \beta \left(\mu' b\right)^{\beta - 1} \right) \frac{1}{\lambda}. \tag{9}$$

Since the investor's risk constraint binds, $\sqrt{b'\Sigma b} = c\left(\mu' b\right)^{\beta} / \alpha$. Substituting this relationship and (9) into (7), we have:

$$b = \frac{c\left(\mu' b\right)^{\beta}}{\alpha} \frac{1}{\sqrt{\mu'\Sigma^{-1}\mu}} \Sigma^{-1} \mu. \tag{10}$$

We can obtain a more useful solution for our comparative statics analysis by pre-multiplying (10) by μ' to obtain:

$$\begin{aligned} \mu' b &= \frac{c\left(\mu' b\right)^{\beta}}{\alpha} \frac{1}{\sqrt{\mu'\Sigma^{-1}\mu}} \mu' \Sigma^{-1} \mu \\ &= \frac{c\left(\mu' b\right)^{\beta}}{\alpha} \sqrt{\mu'\Sigma^{-1}\mu}. \end{aligned}$$

Solving out the generalised Sharpe ratio in (10), we have:

$$
\begin{aligned}
b &= \frac{c\left(\mu' b\right)^{\beta}}{\alpha} \cdot \frac{c\left(\mu' b\right)^{\beta-1}}{\alpha} \Sigma^{-1} \mu && (11) \\
&= \left(\frac{c}{\alpha}\right)^{2} \left(\mu' b\right)^{2\beta-1} \Sigma^{-1} \mu. && (12)
\end{aligned}
$$

Equation (12) defines an implicit function for the optimal bond portfolio b, as b enters both sides of the equation. However, the comparative statics of the optimal portfolio to expected returns μ is clear-cut, since the right-hand side of (12) is increasing in μ. Therefore, the optimal portfolio b is increasing in expected returns μ.

Consider a three-period portfolio choice problem of a global investor who holds emerging market local currency bonds. There are n bonds, one for each emerging market currency. The local currency price of bond i at date t is P_i^t and the date-t value of the ith currency in dollar terms is denoted by Θ_i^t. As a notational convention, subscripts refer to the currency and superscripts refer to the date. In log terms, the dollar value of bond i is denoted by $p_i^t + \theta_i^t$ where $t \in \{0, 1, 2\}$.

The local currency price of bond i follows:

$$p^{t+1} = p^t + \varepsilon^{t+1} \tag{13}$$

where ε^{t+1} is a zero mean random variable with variance σ_ε^2. The bilateral exchange rates $\left\{\theta_i^t\right\}$ follow the stochastic process:

$$\theta_i^{t+1} = \theta_i^t + \delta^{t+1} + \gamma_i^{t+1} \tag{14}$$

so that exchange rate appreciation can be decomposed into a common trend that affects all currencies and an idiosyncratic component for currency i. We assume that the common component δ^{t+1} follows:

$$\delta^{t+1} = \delta^t + \eta^{t+1} \tag{15}$$

where η^{t+1} is a zero mean random variable with variance σ_η^2. The idiosyncratic components γ_i^{t+1} are zero mean random variables with variance σ_u^2, all mutually independent, and independent of η^{t+1}.

Our focus is on the date-1 portfolio decision of the investor conditional on the realisations of δ^1 and $\{\gamma_i^1\}$. Both δ^1 and γ_i^1 are known at date 1 when the investor forms the portfolio. Hence, the expected value of θ_i^2 conditional on date-1 information is:

$$E^1\left(\theta_i^2\right) = \theta_i^1 + \delta^1 + \gamma_i^1 \tag{16}$$

Denote by $\tilde{R}_i$ the return on bond i in dollar terms:

$$\tilde{R}_i \equiv \frac{P_i^{t+1}\Theta_i^{t+1}}{P_i^t\Theta_i^t} - 1 \tag{17}$$

and denote the log return as $\tilde{r}_i \equiv \ln\left(1+\tilde{R}_i\right)$. We write the return from date 1 to date 2 as:

$$\tilde{r}_i = p_i^2 + \theta_i^2 - \left(p_i^1 + \theta_i^1\right). \tag{18}$$

The expected return on bond i at date 1 is then given by:

$$\begin{aligned} E^1\left(\tilde{r}_i\right) &= E^1\left(p_i^2 + \theta_i^2\right) - \left(p_i^1 + \theta_i^1\right) \\ &= E^1\left(\theta_i^2\right) - \theta_i^1 \\ &= \delta^1 + \gamma_i^1. \end{aligned}$$

To see how the optimal bond portfolio depends on expected currency appreciation, we re-write the solution (12) for the optimal portfolio as:

$$\begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix} = \left(\frac{c}{\alpha}\right)^2 \left(\mu' b\right)^{2\beta-1} \begin{bmatrix} & & \\ & \Sigma^{-1} & \\ & & \end{bmatrix} \begin{bmatrix} \mu_1 \\ \vdots \\ \mu_n \end{bmatrix}. \tag{19}$$

Expected currency appreciation enters in two ways in the solution. The first way is through the product $\Sigma^{-1}\mu$. The second way is through the expression $\left(\mu' b\right)^{2\beta-1}$. We consider them in turn.

Given our independence assumptions, Σ is a diagonal matrix with $\sigma_\varepsilon^2 + \sigma_n^2$ along the leading diagonal, where $\sigma_n^2 = \sigma_\eta^2 + \sigma_u^2$. Hence $\Sigma^{-1}\mu$ can be written as:

$$\Sigma^{-1}\mu = \frac{1}{\sigma_\varepsilon^2 + \sigma_n^2} \begin{bmatrix} 1 & \cdots & 0 \\ & \ddots & \\ 0 & & 1 \end{bmatrix} \begin{bmatrix} \delta^1 + \gamma_1^1 \\ \vdots \\ \delta^1 + \gamma_n^1 \end{bmatrix}.$$

In this expression, the common component δ^1 and the idiosyncratic component γ_i^1 enter in an additive way. There is no differential impact of the common component δ compared to the idiosyncratic component γ_i.

However, the differential impact between the common component and the idiosyncratic component comes when we consider the risk-taking channel through the expression $\left(\mu' b\right)^{2\beta-1}$ in (19). The common component δ raises the expected returns on *all* bonds, thereby having a much larger impact on $\left(\mu' b\right)^{2\beta-1}$. The interpretation is that a broad appreciation of all currencies raises economic capital, and hence the degree of risk-taking by the investor. Formally:

$$\begin{aligned}
\begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix} &= \left(\frac{c}{\alpha}\right)^2 (\mu' b)^{2\beta-1} \begin{bmatrix} & & \\ & \Sigma^{-1} & \\ & & \end{bmatrix} \begin{bmatrix} \mu_1 \\ \vdots \\ \mu_n \end{bmatrix} \\
&= \left(\frac{c}{\alpha}\right)^2 \left(\textstyle\sum_{k=1}^n (\delta + \gamma_k) b_k\right)^{2\beta-1} \frac{1}{\sigma_\varepsilon^2 + \sigma_n^2} \begin{bmatrix} 1 & \cdots & 0 \\ & \ddots & \\ 0 & & 1 \end{bmatrix} \begin{bmatrix} \delta^1 + \gamma_1^1 \\ \vdots \\ \delta^1 + \gamma_n^1 \end{bmatrix} \\
&= \left(\frac{c}{\alpha\sqrt{\sigma_\varepsilon^2 + \sigma_n^2}}\right)^2 \left(\textstyle\sum_{k=1}^n (\delta + \gamma_k) b_k\right)^{2\beta-1} \begin{bmatrix} \delta^1 + \gamma_1^1 \\ \vdots \\ \delta^1 + \gamma_n^1 \end{bmatrix}.
\end{aligned} \tag{20}$$

Hence, we can solve for the holding of bond i as:

$$b_i = \left(\frac{c}{\alpha\sqrt{\sigma_\varepsilon^2 + \sigma_n^2}}\right)^2 \left(\textstyle\sum_{k=1}^n (\delta + \gamma_k) b_k\right)^{2\beta-1} \left(\delta^1 + \gamma_i^1\right). \tag{21}$$

For a diversified portfolio where the holding of an individual bond is small relative to the portfolio, the appreciation of currency i due to the idiosyncratic term γ_i^1 has only a small impact on the optimal bond holding. Using the approximation:

$$\frac{d}{d\gamma_k^1} (\mu' b) \simeq 0, \tag{22}$$

it can be shown from the implicit differentiation of (21) that:

$$\frac{db_i}{d\delta^1} > \frac{db_i}{d\gamma_i^1}. \tag{23}$$

We can therefore state our main proposition as follows.

Proposition 1 *For a diversified portfolio, the appreciation of currency i due to an increase in δ raises b_i by more than the same appreciation due to an increase in the idiosyncratic component γ_i.*

We thus have the main empirical predictions of our paper. Expected appreciation of an emerging market currency will raise the bond holdings in that currency by global investors. Crucially, for a given percentage appreciation of the currency, if the appreciation is part a broad-based appreciation of emerging market currencies against the dollar, the bond holdings in that currency will be larger than if the same percentage appreciation is due to an idiosyncratic appreciation.

This prediction sheds light on the dollar exchange rate as a barometer of risk-taking. A broad-based depreciation of the dollar against a basket of emerging market currencies raises risk-taking capacity of global investors, and leads to the increased holdings of a basket of bonds in those currencies. In this way, the broad dollar index serves as an indicator of risk appetite. Expected depreciation of the broad dollar index increases risk appetite.

3 Data

In the empirical analysis, we assess the predictions of the model using fund-country level bond flow data for a panel of 20 EMEs[1] over the period from January 2011 to June 2020 and security-level bond spread data for a panel of up to 20 EMEs over the period from January 2011 to December 2022. As explanatory variables, we use exchange rate shocks as well as a set of standard financial and macroeconomic controls.

3.1 Bond portfolio flows

The amount of purchases by EME bond funds is calculated from the procedure used in Shek et al. (2018) with EPFR Global data on EME bond funds' asset allocation across EMEs and investor flows to these funds as input. In particular, we use the value of an EME's local currency government bonds purchased by a bond fund over a month normalised by the value of total net assets (TNA) of the fund at the beginning of the month. The frequency of the data is monthly in an unbalanced panel with between 4 and 114 consecutive (ie, no break) monthly data points available. The data cover the 20 EMEs for 55 EME local currency government bond funds (on average 58 monthly observations). This yields more then 46,000 monthly country-fund level observations (Table 1).

Figure 1 shows the local currency bond purchases by mutual funds investing in EMEs from January 2011 to June 2020. Since we have 55 bond funds in the sample, we first construct the average value of bond purchase/TNA at the country level in each month using a weighted average of individual funds' bond purchase/TNA, which is calculated as the ratio of the sum of individual funds' bond purchases to the sum of these funds' TNA. Figure 1 displays the time-series behaviour of the median value of bond purchase/TNA

[1] Twenty EMEs are Brazil, Chlie, China, Colombia, the Czech Republic, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Singapore, South Africa, Thailand and Turkey.

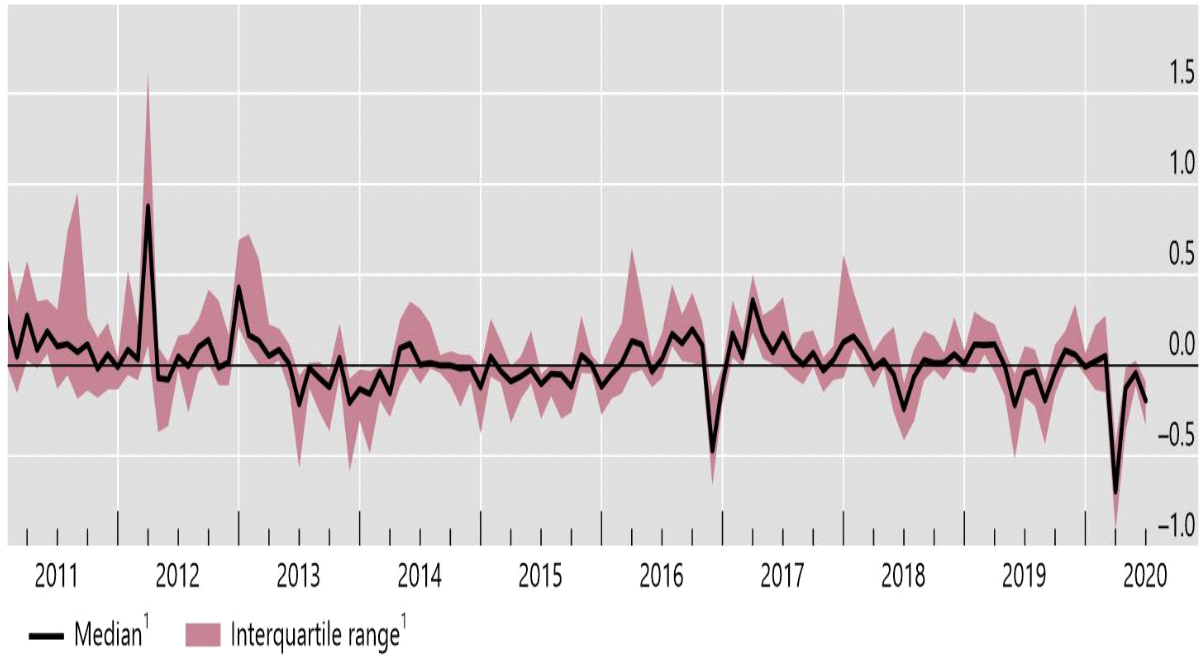

Figure 1. **Dynamics of EME local currency bond purchase by mutual funds.** The black line shows the median value of the local currency bond purchases divided by TNA in per cent by 55 funds in the sample at the country level for 20 EMEs. The red shaded band shows the interquartile range of the ratio of bond purchases to TNA. Sources: EPFR; Bloomberg; JPMorgan Chase; authors' calculations.

along with the interquartile range of bond purchase/TNA constructed at the country level. EME local currency bond purchases tend to be positive in normal times, but become negative during periods of market stress and US dollar strength such as the Taper Tantrum in 2013, post-US presidential election at the end of 2016, and the onset of the COVID-19 pandemic in early 2020. Finally, we find that the width of the interquartile ranges remained relatively stable over the sample period except when EME bond funds tended to increase bond purchases on the backdrop of weakening US dollars. These findings suggest that global factors played a more important role during this period than EMEs' country-specific factors in explaining the behaviour of bond flows to EMEs.

3.2 Bond spreads and credit risk premia

We calculate bond spreads from daily security-level data on the yield of local currency government bonds with different maturities issued by 20 EMEs and daily security-level data on the yield of US Treasuries with different maturities obtained from Refinitiv.

In order to avoid outliers affecting the regression results, we filter out extraordinarily large jumps in the time series of security-level bond yields by using two filters: the first

	Mean	Std. Dev	Observations	Countries
Bond purchase/TNA (monthly, Jan 2011 - Jun 2020)	0.0176	1.4904	46,482	20
Shocks to the bilateral US dollar exchange rate				
All observations (absolute value)	0.0615	0.2402	50,271	20
Non-zero observations (absolute value)	0.4311	0.4950	7,171	20
Shocks to the broad US dollar index				
All observations (absolute value)	0.0353	0.1253	50,500	20
Non-zero observations (absolute value)	0.2418	0.2400	7,380	20
Local currency bond spread (daily, Jan 2011 - Dec 2022)	3.4956	3.8900	1,670,243	20
Shocks to the bilateral US dollar exchange rate				
All observations (absolute value)	0.0443	0.1859	1,670,243	20
Non-zero observations (absolute value)	0.3374	0.4053	219,489	20
Shocks to the broad US dollar index				
All observations (absolute value)	0.0298	0.1115	1,670,243	20
Non-zero observations (absolute value)	0.2263	0.2238	219,489	20
Local currency credit risk premium (daily, Jan 2011 - Dec 2022)	0.8680	2.3040	813,462	16
Shocks to the bilateral US dollar exchange rate				
All observations (absolute value)	0.0529	0.1976	813,462	16
Non-zero observations (absolute value)	0.3524	0.3934	122,025	16
Shocks to the broad US dollar index				
All observations (absolute value)	0.0356	0.1253	813,466	16
Non-zero observations (absolute value)	0.2371	0.2384	122,025	16

Table 1. **Descriptive Statistics for Bond Purchase, Bond Spreads and Exchange Rate Shocks.**
In per cent.

filter deletes observations from the sample when the absolute value of the daily change (either increase or decrease) in the security-level bond yield exceeds 3 standard deviations, and the second one excludes a sharp spike up (or down) quickly followed by a spike down (or up) (that is, an extraordinarily large jump in the yield in one direction followed by a very large jump in the yield in the opposite direction).[2] When we calculate the bond spread, we subtract the benchmark 5-year US Treasury yield from the yield of a government bond issued by an EME.

The analysis relies on three different data sources from Refinitiv. First, Refinitiv yield data on active bonds as of early 2023 (that is, bonds which have not matured by early 2023). Most papers using security-level data rely on data on active bonds from Bloomberg or Refinitiv. Second, we use Refinitiv's application programming interface (API) to download security-level bond yield data for matured bonds (which existed before 2023 but matured and disappeared by early 2023). Third, we also use data on matured bonds' yields from Refinitiv after identifying the ISINs of matured bonds issued by the 20 EME governments.

In total, we have collected daily time-series data on security-level bond yields amounting to around 1.75 million observations (after filtering) for 2,647 government bonds issued by the 20 EMEs.[3] Table 2 provides an overview of the number of securities and bond yield observations for each EME. Figure 2 provides examples of the yield of four government bond securities issued by Chile, Korea, Poland and South Africa, respectively, in comparison with their respective country-level JPMorgan GBI-EM index. We find that the level of the security-level bond yield is close to but different from the benchmark yield during the sample period, but that the time-series dynamics of the security- and country-level yields are very similar.

The empirical analysis is based on sovereign yields and local currency/US dollar cross-currency swap rates. We consider two different spreads in our empirical investigation: the local currency bond spread and the local currency credit risk premium.

The *local currency bond spread* ($s^{LC}_{b,i,t}$) is defined as the spread between the local

[2] For the first filter, we calculate the standard deviation for each economy from the JPMorgan GBI-EM country-level index. For the second filter, we identify a sharp spike whose size is more than 3 standard deviations followed by an opposite move whose size is more than 2 standard deviations within three days.

[3] Among the 2,647 bonds and 1.75 million observations for 20 EMEs after filtering, 64% of bonds and 67% of observations are from active bonds as of early 2023, while 36% of bonds and 33% of observations are from the bonds which matured before early 2023.

Country	No of bonds	Total no of obs	Average no of obs per bond
Brazil	70	34,910	499
Chile	48	40,144	836
China	338	206,640	611
Colombia	37	21,882	591
Czech Republic	158	79,659	504
Hungary	37	18,390	497
India	877	494,641	564
Indonesia	34	28,472	837
Israel	32	21,474	671
Korea	291	271,786	934
Malaysia	87	67,670	778
Mexico	120	63,686	531
Peru	23	18,856	820
Philippines	97	110,239	1,136
Poland	27	21,159	784
Russia	53	33,408	630
Singapore	52	43,597	838
South Africa	49	59,111	1,206
Thailand	98	67,896	693
Turkey	119	45,117	379
Total	2,647	1,748,737	661

Table 2. **Overview of the security-level EME bond yield dataset.**

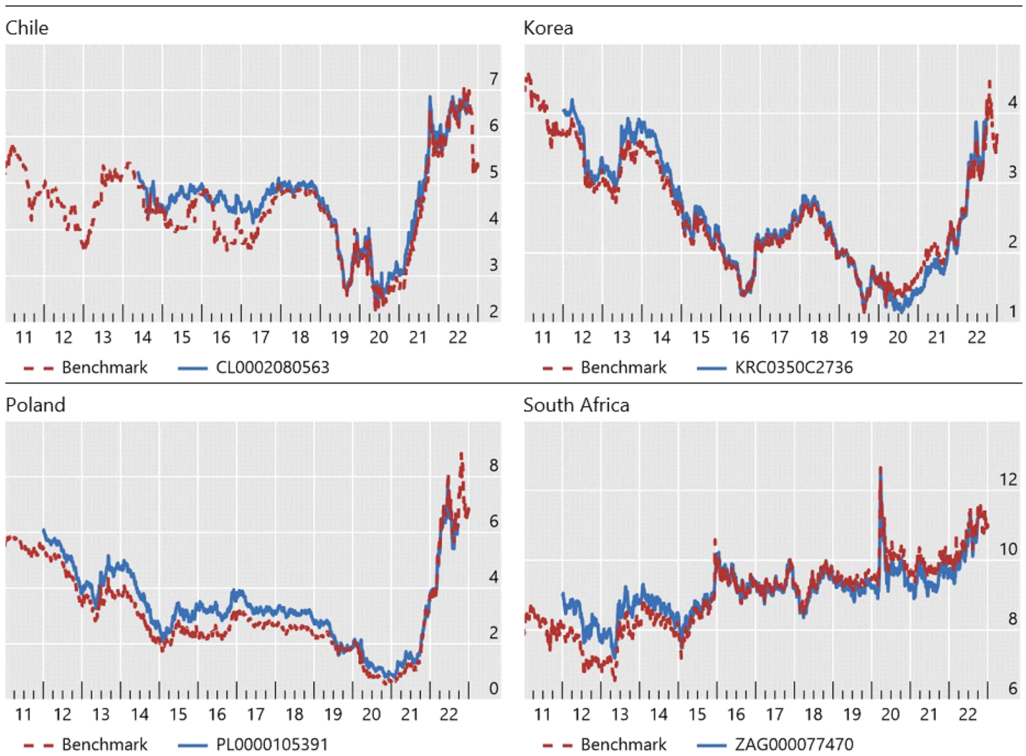

Figure 2. **Examples of security-level bond yields in select EMEs.** The red dotted line shows the daily bond yield of the JPMorgan GBI-EM country-level index. The blue solid line shows the daily yield of the government bond security whose ISIN is provided in the legend. Sources: JPMorgan; Refinitiv; authors' calculations.

currency government bond yield ($y^{LC}_{b,i,t}$) and the US Treasury yield ($y^{\$}_{t}$), where i denotes an EME, b a security issued by an EME i, and t a date:

$$s^{LC}_{b,i,t} = y^{LC}_{b,i,t} - y^{\$}_{t} \tag{24}$$

The local currency bond spread is available for the 20 EMEs.

The *local currency credit risk premium* ($s^{DS}_{b,i,t}$), following Du and Schreger (2016), is the spread between the local currency government bond yield and the synthetic local currency yield available to a dollar-based investor. This synthetic yield is given by the sum of the US Treasury yield and the cross-currency swap rate ($y^{CCS}_{i,t}$), achievable by a dollar-based investor who has access to the local currency bond as well as the cross-currency swap contract of the same maturity:

$$s^{DS}_{b,i,t} = y^{LC}_{b,i,t} - y^{\$}_{t} - y^{CCS}_{i,t} \tag{25}$$

The underlying assumption here is that a dollar-based investor can lock in the local currency spread by eliminating the currency risk through a swap contract that converts, at the outset, the cash flow from the local currency bonds into the US dollar. As shown by Du and Schreger (2016), the level and the dynamics of local currency credit risk spreads are quite different from those of foreign currency risk spreads, potentially reflecting several risk factors for the dollar-based investor, such as (i) covariance between currency and credit risk (quanto adjustment), (ii) selective default and capital control risk, and (iii) financial market frictions, including specific frictions in local currency bond markets and the failure of covered interest parity (CIP). If exchange rates affect local currency bond market conditions through a risk-taking channel, we would expect to see in particular a significant link between exchange rate changes and shifts in the Du-Schreger local currency credit risk premium. The credit risk spread is available for 16 EMEs due to lack of cross-currency swap rate data.[4]

Table 1 shows that EME local currency spreads averaged 3.5 percentage points, with a standard deviation of 3.9 percentage points reflecting the repeated bouts of volatility in these markets over this period. The local currency risk premium averaged 0.9 percentage points, which is around a quarter of the local currency bond spread, with a standard deviation of 2.3 percentage points.

[4] Sixteen EMEs are Brazil, China, Colombia, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, South Africa, Thailand and Turkey. The total number of securities for these 16 EMEs is 2,336.

Figures 3 and 4 show the local currency spread and the local currency credit risk premium, respectively, from 2011 to 2022. Because the number of local currency government bonds included in the dataset varies substantially from economy to economy as documented in Table 2, we first construct local currency sovereign bond spreads at the country level in each month using a weighted average of individual bond spreads where the weights in any period are the month-end market value of each bond issued by an EME government relative to the sum of the month-end market value of all bonds issued by the EME government in the sample. Figures 3 and 4 display the time-series behaviour of the median value along with the interquartile range of the local currency sovereign spread and the Du-Schreger spread, respectively, constructed at the country level. EME local currency bond spreads appear to have a substantial common or global component. In particular, since the peak of the European sovereign debt crisis in 2012, both the EME local currency spread and the EME local currency credit risk premium had gradually declined and remained at low levels until 2019. After the onset of the COVID-19 pandemic in 2020, these local currency spreads spiked to high levels and then came down quickly. During the period of rapid global rate hikes in 2022, EME local currency bond spreads rose, whereas the local currency credit risk premia did not rise. Except in the second half of 2022 when the volatility of the median spreads increased and the interquartile range substantially widened, the median value and the width of the interquartile range remained relatively stable over the sample period, which suggests that EMEs' country-specific factors did not play an important role.

3.3 Exchange rate shocks

In order to mitigate the endogeneity problems that arise from the joint determination of yield changes and exchange rate changes, we employ a database of exchange rate shocks that arise from monetary policy news from major advanced economies (AEs). We consider shocks to the nominal bilateral exchange rate against the US dollar and to the broad dollar index, both measured such that an increase is an appreciation of the US dollar.

Specifically, we construct a shock measure that is equal to the log change in the respective exchange rates on days of monetary policy news from the ECB or the BOJ, taking into account differences in time zones, and zero on the other days. We do not consider news related to monetary policy announcements of the Federal Reserve as these

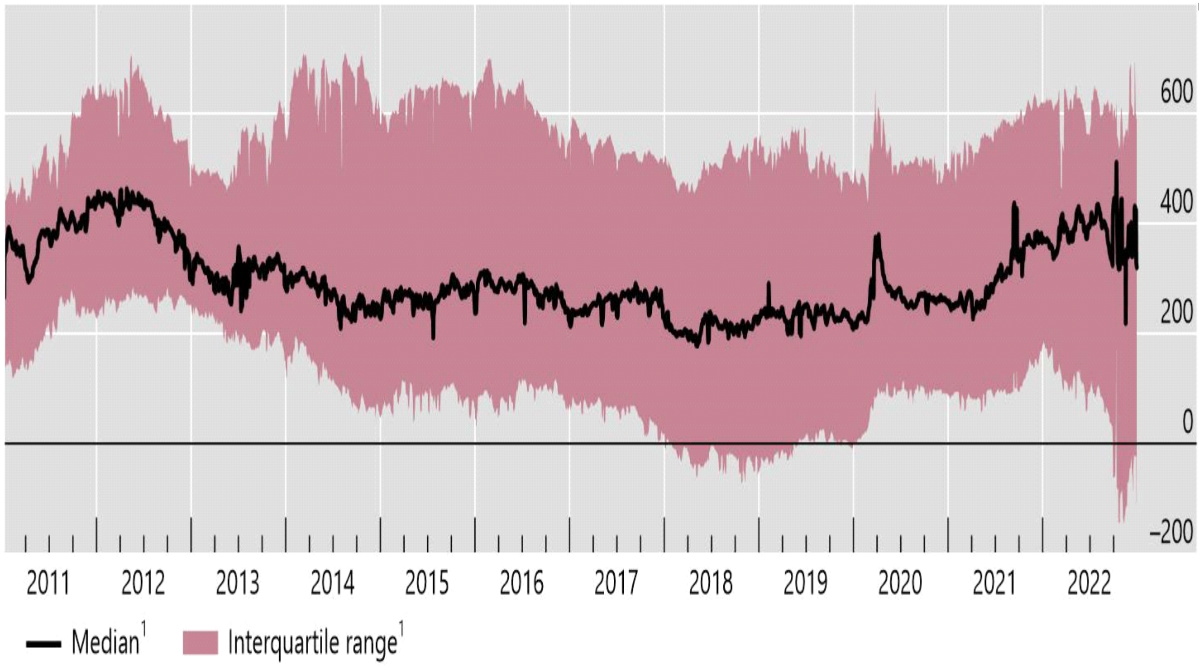

Figure 3. **Dynamics of EME local currency bond spread.** The black line shows the median value of the local currency bond spread at the country level for 20 EMEs. The red shaded band shows the interquartile range of the spread. Sources: Bloomberg; Refinitiv; authors' calculations.

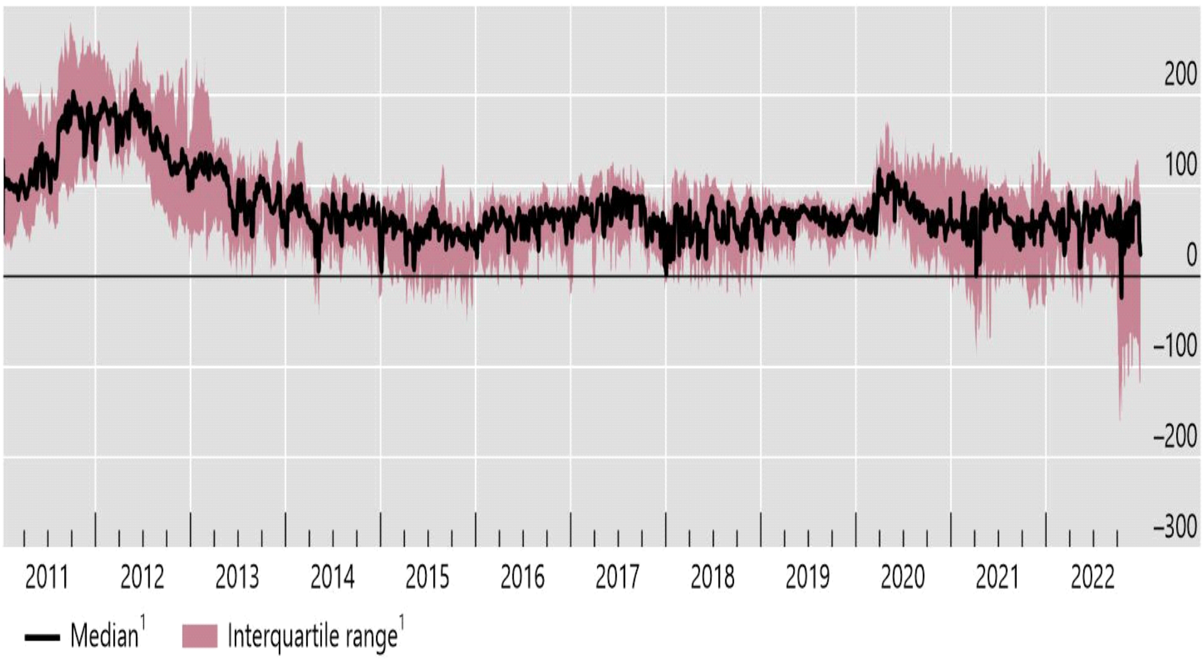

Figure 4. **Dynamics of EME local currency credit risk premium.** The black line shows the median value of the local currency credit risk premium (Du-Schreger spread) at the country level for 16 EMEs. The red shaded band shows the interquartile range of the premium. Sources: Bloomberg; Refinitiv; authors' calculations.

could shift not only the exchange rate but also the bond spread which is measured relative to the US Treasury yield. Our database of monetary policy news comes from the updated version of the monetary policy news database developed by Ferrari et al. (2017).

The monetary policy news dates comprise both scheduled monetary policy events such as the release of information on the outcomes of policy meetings (e.g. policy announcements and publication of minutes) and non-scheduled events (e.g. key speeches and press releases) that reveal news about unconventional policies such as asset purchases or forward guidance. In total, there were 340 days of monetary policy news from the ECB or the BOJ over the sample period which covers in total 2,477 working days.

Denote by N the set of dates with ECB or BOJ news. The exchange rate shocks[5] to an EME i, $\triangle BER^S_{i,t}$ and $\triangle USD^S_t$, are then calculated as follows:

$$\triangle BER^S_{i,t} = \begin{cases} \triangle BER_{i,t} \text{ if } t \in N \\ 0 \text{ otherwise} \end{cases} \tag{26}$$

$$\triangle USD^S_t = \begin{cases} \triangle USD_t \text{ if } t \in N \\ 0 \text{ otherwise} \end{cases} \tag{27}$$

where $\triangle BER_{i,t}$ and $\triangle USD_t$ are, respectively, the daily log change in the bilateral exchange rate of an EME i's currency against the US dollar and that in the broad US dollar index.

The average size of non-zero daily changes in BER and USD on days of ECB or BOJ monetary policy news is 0.43 per cent and 0.04 per cent, respectively (Table 1). The ratio of the mean and standard deviation of the non-zero BER shocks is around 0.9, while the ratio of the non-zero USD shocks is around 1.

3.4 Macro-financial controls

In the analysis, we control for common factors that could drive both exchange rates and bond flows or bond spreads/premia. We consider three main factors. The first factor is the VIX index. Low VIX is commonly associated with portfolio inflows to EMEs, appreciating EME currencies and pushing down bond spreads. The second factor is changes in domestic monetary conditions in the United States and EMEs captured by

[5] We also performed the analysis using actual log changes of exchange rates, rather than the exchange rate shocks from monetary policy news. In general, the effects were qualitatively similar but quantitatively much smaller when we used actual exchange rate changes, suggesting that our approach of using the exchange rate shocks from the monetary policy news database enables a better identification of the impact of the risk-taking channel. The results of this exercise are available upon request.

changes in the short-term interest rate. For instance, a tightening in domestic short-term interest rates may impact the currency as well as bond spreads. The third factor is foreign and domestic macroeconomic conditions, captured through the log changes in US and EMEs' CPI and industrial production, respectively. Other candidate common factors, such as the change in global commodity or oil prices, were not included in the final regressions as they did not enter the regressions in a significant way and also did not affect the estimated impact of exchange rate shocks.

4 Exchange rates and EME bond flows

Our portfolio choice model outlined in Section 2 predicts that a broad-based dollar appreciation should dampen portfolio bond flows into EMEs, and that the effect of a broad dollar appreciation should be larger than that of an appreciation of the bilateral exchange rate against the dollar. To test this hypothesis, we estimate the impact of exchange rate shocks on the normalised purchase of an EME i's local currency bonds by a bond fund j in month t (henceforth, bond flows).

We first do this separately both for the US dollar index and for the bilateral dollar exchange rate. Specifically, we run the following panel regressions at the monthly frequency:

$$f_{i,j,t} = \alpha_j + \rho f_{i,j,t-1} + \beta \Delta BER^S_{i,t} + \Gamma Z_{i,t-1} + \eta_{i,j,t} \quad (28)$$

$$f_{i,j,t} = \alpha_j + \rho f_{i,j,t-1} + \delta \Delta USD^S_t + \Gamma Z_{i,t-1} + \eta_{i,j,t}. \quad (29)$$

where $f_{i,j,t}$ denotes the purchases of local currency bonds of country i by bond fund j in percent of total net assets of bond fund j. $\Delta BER^S_{i,t}$ and ΔUSD^S_t are, respectively, the shocks to the bilateral US dollar exchange rate of country i and to the broad US dollar index, as described in the previous section. A positive value of the shock is respectively an appreciation shock to the US dollar. The vector of control variables Z includes the percentage change in the VIX index, capturing changes in global investor risk appetite, and the change in domestic and in US short-term interest rate as the primary gauge of changes in domestic and US monetary conditions as well as the log changes of US and domestic CPI and industrial production.[6] The regressions include fund fixed effects[7] α_j

[6] The results are unaffected by adding the change in the 5-year US Treasury yield as an additional control variable.

[7] The baseline specification includes fund fixed effects and uses clustered standard errors by fund.

and the one-month lagged dependent variable.[8] The coefficient estimates $\widehat{\beta}$ and $\widehat{\delta}$ from equations (28) and (29) provide the impact of a 1 percent appreciation shock to the BER and to the USD, respectively.

In order to shed further light on the respective role of the two exchange rates for bond flows in EMEs, we also run a "horse-race" regression to test which exchange rate dominates the other. We do this by including both exchange rate shocks in the regression:

$$f_{i,j,t} = \alpha_j + \rho f_{i,j,t-1} + \beta \Delta BER^S_{i,t} + \delta \Delta USD^S_t + \Gamma Z_{i,t-1} + \eta_{i,j,t} \tag{30}$$

Table 3 reports the coefficients on $\triangle BER^S$ on $\triangle USD^S$ obtained through these exercises. The coefficient on $\triangle BER^S$ in columns (1) and (3) shows the impact of a 1 percent appreciation shock of the US dollar against an EME's local currency, and the coefficient on $\triangle USD^S$ in columns (2) and (3) the impact of a 1 percent broad US dollar appreciation shock. Therefore, a negative coefficient means that when the dollar appreciates, an EME bond fund sells EME bonds. Table 3 shows that an appreciation of the US dollar has a significantly negative impact on EME local currency bond flows. Moreover, the effects of a broad US dollar appreciation are consistently larger than those of a bilateral dollar appreciation against the EME currency. We find that the coefficient on the broad dollar index is statistically significant under both specifications and that the coefficient on the broad dollar index is statistically significantly greater in magnitude than that on the bilateral exchange rate. These findings are consistent with the prediction of the theoretical model that it is a broad-based rather than a bilateral appreciation of the dollar that drives bond flows in EMEs.

As a robustness check, we also perform the analysis using exchange rate shocks for five alternative US dollar indexes: the BIS EME-only dollar index, the BIS AE-only dollar index, the principal component-weighted dollar index, the BIS 10-by-10 dollar index and

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As robustness checks, we also consider different combinations of fixed effects and clustered standard errors. In particular, we (i) include country fixed effects and use clustered standard errors by country; (ii) include country fixed effects and fund fixed effects and use clustered standard errors by country; (iii) include country fixed effects and use clustered standard errors by fund; and (iv) include country fixed effects and fund fixed effects and use clustered standard errors by fund. In all these specifications, the coefficients on the dollar exchange rates remain almost the same and statistically significant.

[8] The inclusion of a lagged dependent variable in fixed-effects panel estimations can give rise to biases in panels with small time dimensions (Nickell (1981)). However, with 234 monthly observations, the time dimension of our panel is quite large so that the Nickell bias should not be of concern to us. This assumption is validated by the fact that the results are virtually identical when we re-run the regressions with the lagged dependent variable excluded.

	(1)	(2)	(3)
	Separate BER	Separate USD	Simple Joint
Bilateral exchange rate (BER)	−0.017***		−0.003
	(−2.68)		(−0.47)
Dollar Index (USD)		−0.071***	−0.067***
		(−5.33)	(−4.59)
N	44281	44281	44281
R-squared	0.025	0.025	0.025

Table 3. **Sensitivity of local currency bond purchases to exchange rate shocks for all EMEs.** This table shows the coefficients on the change in the bilateral US dollar exchange rate and the broad US dollar index on days of ECB or BOJ monetary policy announcements in a monthly panel regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds (on average 58 monthly observations). A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the broad dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses.

the BIS financially-weighted dollar index.[9] The Annex provides five tables showing the pairs of the coefficients from regressions using the five alternative dollar indexes. We find quantitatively similar results when we use the alternative dollar indexes, which supports the robustness of our theoretical prediction.

Table 3 shows the average effect of the two dollar exchange rates across the 20 EMEs. It is possible that such an effect may differ by country, and that a small number of countries drive the average effect. In order to gauge the impact of the two dollar exchange rates country by country, we conduct mean group separate regressions in which we estimate country-specific coefficients on either of the two dollar exchange rates. Table 4 shows a pair of the coefficients from separate regressions for each EME. We find that

[9] The principal component-weighted US dollar index considers the same list of AEs and EMEs in the broad dollar index but uses country weights calculated from the factor loadings of a principal component analysis of bilateral exchange rates of these countries against the US dollar. The BIS 10-by-10 dollar index is a simple average of ten bilateral exchange rates against the US dollar of five AE currencies (Australian dollar, Canadian dollar, Swiss franc, British pound and euro) and five EME currencies (Brazilian real, Indian rupee, Korean won, Mexican peso and Russian ruble) with 10% weight for each currency. The BIS financially-weighted dollar index is an weighted average of 11 bilateral exchange rates (Australian dollar, Canadian dollar, Swiss franc, British pound, euro, Brazilian real, Chinese yuan, Indian rupee, Korean won, Mexican peso and Russian ruble) against the US dollar, where the weights are the coefficients on the exchange rate variables in the first principal component of 24 financial variables.

a broad US dollar appreciation has impacts larger in magnitude than a bilateral dollar appreciation against an EME currency for 15 out of 20 EMEs, while the coefficient on the broad dollar index is close to that on the bilateral dollar exchange rate for the other five EMEs.[10]

Moreover, the average value of the country-specific coefficients reported in the bottom row of Table 4 also confirms the results. We find that the negative coefficient on the broad dollar index is statistically significant and that the coefficient on the broad dollar index is statistically significantly greater in magnitude than that on the bilateral exchange rate.

5 Exchange rates and EME bond spreads

For the daily security-level bond spread data, we assess the dynamic effects of exchange rate shocks using panel local linear projection (*LLP*) regressions. The *LLP* method due to Jordà (2005) has become a standard tool in empirical analyses to derive dynamic impulse responses. Compared to vector autoregressions (VARs), it is regarded as being more robust to misspecification because it does not impose implicit dynamic restrictions on the shape of the impulse responses.[11]

We run *LLP* regressions over horizons up to 30 working days. We regress the change in an EME i's sovereign bond b's spread against US Treasury (denoted by s) over the next h days on their own lags as well as on the exchange rate shocks and a set of lagged control variables (Z).

Specifically, we run the following regressions:

$$s_{b,i,t+h} - s_{b,i,t-1} = \alpha_{h,b,i} + \rho_h(L)\Delta s_{b,i,t-1} + \beta_h \Delta BER^S_{i,t} + \Gamma_h Z_{i,t-1} + \eta_{b,i,t+h} \quad (31)$$

$$s_{b,i,t+h} - s_{b,i,t-1} = \alpha_{h,b,i} + \rho_h(L)\Delta s_{b,i,t-1} + \delta_h \Delta USD^S_{t} + \Gamma_h Z_{i,t-1} + \eta_{b,i,t+h} \quad (32)$$

for $h = 1, ..., 30$. The vector of control variables Z includes the percentage change in the VIX index capturing changes in global investor risk appetite, and the change in the domestic short-term interest rate as the primary gauge of changes in domestic monetary conditions in EMEs and the United States. The regressions include bond fixed effects

[10] We also run country-by-country separate regressions for the 20 EMEs and obtain similar but slightly weaker results. In addition, when we run mean group or country-by-country joint regressions, we obtain similar but weaker results. These results are available from the authors upon request.

[11] Plagborg-Møller and Wolf (2021) provide a formal derivation of the equivalence of impulse responses obtained from local projections and VARs for such recursive identification schemes.

	Bilateral exchange rate		Dollar index	
BR	−0.013	(−0.55)	−0.126*	(−1.94)
CL	−0.036	(−1.18)	−0.021	(−0.87)
CN	−0.014	(−0.23)	0.022	(0.63)
CO	−0.029	(−1.61)	0.039	(1.02)
CZ	0.018	(1.11)	0.001	(0.02)
HU	0.027	(1.17)	0.009	(0.27)
ID	−0.049	(−1.63)	−0.079	(−1.31)
IL	−0.093	(−1.52)	−0.159**	(−2.11)
IN	0.053*	(1.73)	0.039	(1.25)
KR	−0.064	(−1.09)	−0.129	(−1.58)
MX	−0.015	(−1.08)	−0.148***	(−3.41)
MY	−0.003	(−0.06)	−0.106***	(−2.93)
PE	−0.054**	(−2.05)	−0.010	(−0.50)
PH	0.031	(1.56)	0.008	(0.33)
PL	−0.072***	(−2.96)	−0.151***	(−4.41)
RU	−0.015	(−1.38)	−0.097**	(−2.57)
SG	−0.086	(−0.92)	−0.100	(−1.03)
TH	−0.129***	(−3.30)	−0.114***	(−3.72)
TR	−0.007	(−0.35)	−0.105***	(−2.77)
ZA	−0.008	(−0.69)	−0.114***	(−2.72)
Average	−0.028***	(−2.99)	−0.067***	(−3.82)

Table 4. **Impact of exchange rate shocks on EME local currency bond purchases for individual EMEs.** This table shows the country-specific coefficients on the change in the bilateral US dollar exchange rate and the broad US dollar index on days of ECB or BOJ monetary policy announcements in a monthly mean group regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds. A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the broad dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors' calculations.

$\alpha_{h,b,i}$ and a lagged dependent variable.[12] L is the lag operator and we include five lags of the daily change in the respective bond spread in order to mitigate serial correlation of the error term. The series of coefficient estimates $\widehat{\beta}_1, ..., \widehat{\beta}_{30}$ and $\widehat{\delta}_1, ..., \widehat{\delta}_{30}$ from equations (31) and (32) provide the impulse responses to a 1 percent appreciation shock to the BER and to the USD, respectively.

Also here we run a "horse-race" regression that includes both exchange rate shocks in order to shed further light on the role of the two exchange rates for bond spreads in EMEs:

$$s_{b,i,t+h} - s_{b,i,t-1} = \alpha_{h,b,i} + \rho_h(L)\Delta s_{b,i,t-1} + \beta_h \Delta BER^S_{i,t} + \delta_h \Delta USD^S_t + \Gamma_h Z_{i,t-1} + \eta_{b,i,t+h} \quad (33)$$

Figures 5 and 6 report impulse responses from the LLP regressions with 90% confidence bands (based on heteroskedasticity and autocorrelation robust standard errors) from separate regressions (equations (31) and (32)) in the upper panels and from a simple joint regression (equation (33)) in the lower panels. The results show that an appreciation shock to the dollar, measured through either the BER or the USD, is followed by significant increases in EME bond spreads. Figure 5 shows that a 1 percent appreciation shock to the BER (top-left panel) is followed by a significant and persistent increase of the local currency bond spread by about 5 basis points. The impact of an appreciation of the USD is more than twice as strong at the peak, at 11 basis points (top-right panel). When both shocks are included simultaneously (bottom panels), the impact of a 1% appreciation of the USD shock at 9 basis points is more than four times as strong at the peak than that of a 1 percent appreciation of the BER shock at 2 basis points.

Figure 6 shows that the impact of the dollar shocks is primarily driven by the local currency credit risk premium (Du-Schreger spread). Quantitatively the impact of dollar appreciation on the credit risk spread is similar to that on the local currency spread. Also here, the impact of an appreciation of the dollar index is larger than that of the bilateral dollar exchange rate. In particular, a 1 percent appreciation shock to the BER (top-left panel) is followed by a significant and persistent increase of the local currency bond spread by about 6 basis points. The impact of an appreciation of the USD is more

[12] The inclusion of a lagged dependent variable in fixed-effects panel estimations can give rise to biases in panels with small time dimensions (Nickell (1981)). However, with about 2,500 daily observations, the time dimension of our panel is quite large so that the Nickell bias should not be of concern to us. This assumption is validated by the fact that the results are virtually identical when we re-run the regressions with the lagged dependent variable excluded.

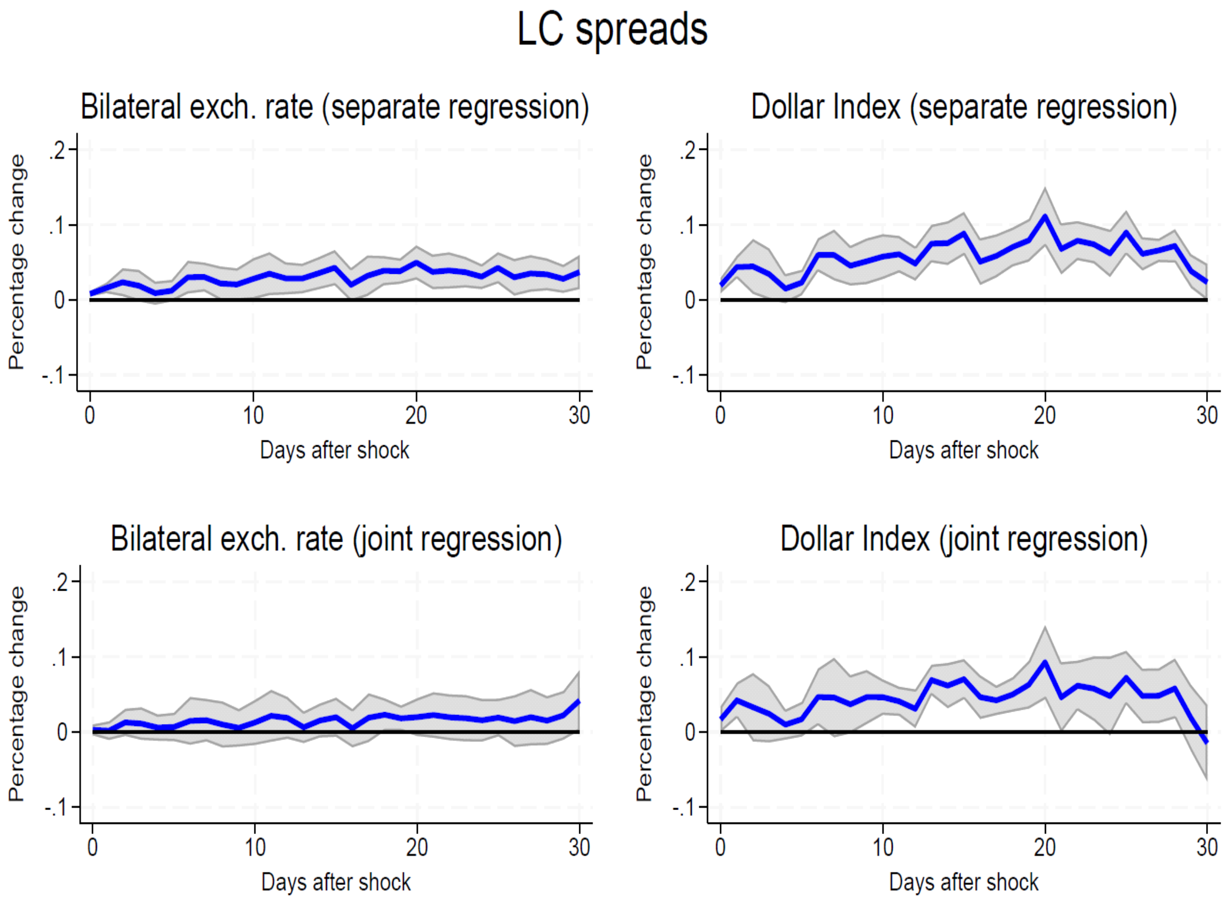

Figure 5. **Impact of US dollar appreciation shocks on EME local currency bond spreads for all EMEs.** The figure shows the impact of a 1 percent appreciation shock (log exchange rate changes on days of ECB or BOJ monetary policy announcements) to the bilateral exchange rate against the US dollar and to the broad dollar index. The 90% confidence bands are based on heteroskedasticity and autocorrelation robust standard errors. Sources: Bloomberg; JPMorgan Chase; authors' calculations.

than twice as strong at the peak, at 13 basis points (top-right panel). When both shocks are included simultaneously (bottom panels), the impact of a 1% appreciation of the *USD* shock at 13 basis points is more than twice as strong at the peak than that of a 1 percent appreciation of the *BER* shock at 5 basis points. This result lends strong support to a risk-taking channel of the exchange rate driving local currency bond spreads through their credit risk premium. Our findings suggest that this channel mainly operates through the broad US dollar index, in line with the predictions of the model.

Figures 5 and 6 show the average effect of the two dollar exchange rates on the local currency bond spread across 20 EMEs and on the Du-Schreger spread across 16 EMEs, respectively. In order to gauge the impact of the two dollar exchange rates for individual

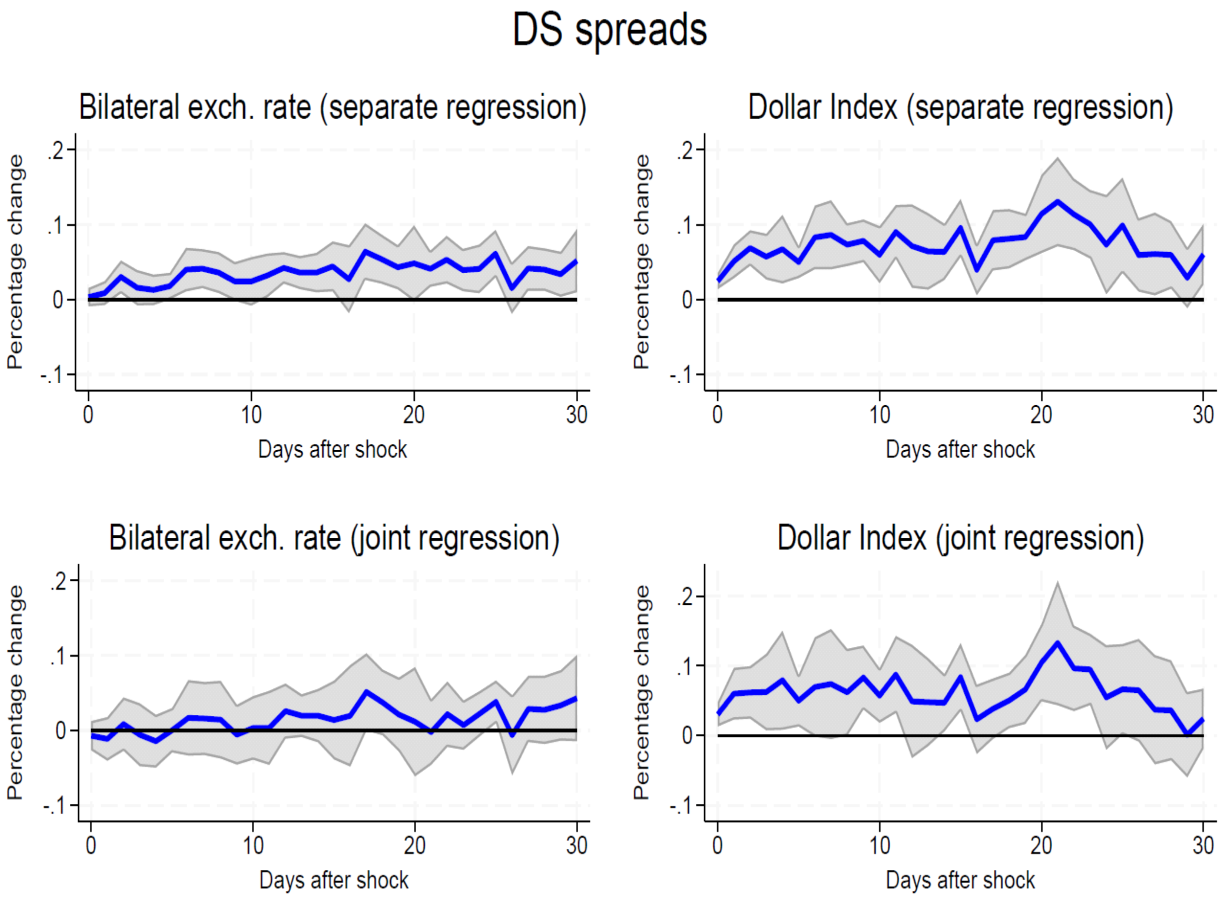

Figure 6. **Impact of US dollar appreciation shocks on EME local currency credit risk spreads for all EMEs.** The figure shows the impact of a 1 percent appreciation shock (log exchange rate changes on days of ECB or BOJ monetary policy announcements) to the bilateral exchange rate against the US dollar and to the broad dollar index. Credit risk spreads are measured following Du and Schreger (2016). The 90% confidence bands are based on heteroskedasticity and autocorrelation robust standard errors. Sources: Bloomberg; JPMorgan Chase; authors' calculations.

EMEs, we conduct mean group separate LLP regressions in which we estimate country-specific coefficients on either of the two dollar exchange rates over the 30-day horizon. Table 5 shows a pair of the coefficients showing the peak impact over the 30-day horizon from separate regressions on the local currency bond spread for each of the 20 EMEs, while Table 6 shows a pair of the coefficients showing the peak impact over the 30-day horizon from separate regressions on the Du-Schreger spread for each of the 16 EMEs. From Table 5, we find that a broad US dollar appreciation has larger peak impacts on the local currency bond spread than a bilateral dollar appreciation against an EME currency for 16 out of the 20 EMEs, while the coefficient on the broad dollar index is very close to that on the bilateral dollar exchange rate for two other EMEs (the Philippines and Thailand). From Table 6, we find that a broad US dollar appreciation has greater peak effects on the local currency bond spread than a bilateral dollar appreciation against an EME currency for 13 out of the 16 EMEs, while the coefficient on the broad dollar index is relatively close to that on the bilateral dollar exchange rate for another EME (the Philippines).[13] Finally, the average value of the country-specific coefficients shown at the bottom of Tables 5 and 6 also confirms the results.

[13] We also run country-by-country separate regressions for the two kinds of bond spreads and obtain similar but slightly weaker results. In addition, when we run mean group or country-by-country joint regressions, we obtain similar but weaker results. These results are available upon request.

	Bilateral exchange rate		Dollar index	
BR	0.145***	(218.43)	0.438***	(186.19)
CL	0.094***	(354.33)	0.129***	(79.44)
CN	0.134***	(40.15)	0.146***	(36.47)
CO	0.129***	(155.23)	0.189***	(90.69)
CZ	0.025***	(32.23)	0.108***	(34.83)
HU	0.126***	(69.63)	0.169***	(43.47)
ID	0.245***	(169.40)	0.326***	(158.89)
IL	0.086***	(247.29)	0.132***	(77.94)
IN	0.142***	(72.39)	0.172***	(36.36)
KR	0.054***	(75.01)	0.099***	(42.85)
MX	0.003***	(8.57)	0.013***	(21.79)
MY	0.068***	(51.91)	0.115***	(58.51)
PE	0.204***	(86.57)	0.155***	(30.33)
PH	0.113***	(54.47)	0.105***	(29.76)
PL	0.053***	(33.43)	0.101***	(42.29)
RU	0.127***	(35.04)	0.084***	(10.39)
SG	0.073***	(29.75)	0.076***	(24.12)
TH	0.060***	(37.18)	0.060***	(13.93)
TR	0.152***	(40.79)	0.531***	(37.39)
ZA	0.008***	(2.52)	0.019***	(3.78)
Average	0.102***	(7.35)	0.158***	(5.42)

Table 5. **Peak impact of exchange rate shocks on EME local currency bond spread for individual EMEs.** The coefficient values show the peak impact of a 1 percent broad US dollar appreciation shock/bilateral US dollar exchange rate shock (defined as the change in the broad US dollar index/bilateral exchange rate on days of ECB or BOJ monetary policy announcements) over the 30-day horizon. An increase in the bilateral exchange rate is an appreciation of the US dollar and thus a depreciation of the EME currency. An increase in the US dollar index is an appreciation of the US dollar broadly. Therefore, a positive coefficient means that when the dollar appreciates, an EME's local currency bond spread increases. The coefficients are from daily mean group separate regressions for 20 EMEs from January 2011 to December 2022. The coefficients on the lagged dependent variable and control variables are not reported in this table. t-statistics are in parentheses. Sources: Bloomberg; Refinitive; authors' calculations.

	Bilateral exchange rate		Dollar index	
BR	0.183***	(102.49)	0.641***	(398.59)
CN	0.190***	(91.55)	0.117***	(6.43)
CO	0.063***	(43.05)	0.255***	(255.83)
HU	0.099***	(236.15)	0.182***	(443.87)
ID	0.255***	(91.72)	0.195***	(18.63)
IL	0.121***	(265.31)	0.150***	(358.83)
IN	0.152***	(12.79)	0.177***	(12.55)
KR	0.063***	(34.30)	0.166***	(91.14)
MX	0.008***	(7.74)	0.055***	(72.37)
MY	0.085***	(27.35)	0.174***	(158.63)
PE	0.223***	(101.26)	0.268***	(148.02)
PH	0.084***	(89.48)	0.071***	(58.56)
PL	0.063***	(43.37)	0.093***	(64.22)
TH	0.057***	(52.38)	0.289***	(268.14)
TR	0.262***	(86.24)	0.616***	(363.19)
ZA	0.052***	(41.01)	0.163***	(125.61)
Average	0.122***	(6.22)	0.226***	(5.30)

Table 6. **Peak impact of exchange rate shocks on EME local currency credit risk spread for individual EMEs.** The coefficient values show the peak impact of a 1 percent broad US dollar appreciation shock/bilateral US dollar exchange rate shock (defined as the change in the broad US dollar index/bilateral exchange rate on days of ECB or BOJ monetary policy announcements) over the 30-day horizon. An increase in the bilateral exchange rate is an appreciation of the US dollar and thus a depreciation of the EME currency. An increase in the US dollar index is an appreciation of the US dollar broadly. Therefore, a positive coefficient means that when the dollar appreciates, an EME's local currency credit risk spread increases. The coefficients are from daily mean group separate regressions for 20 EMEs from January 2011 to December 2022. The coefficients on the lagged dependent variable and control variables are not reported in this table. t-statistics are in parentheses. Sources: Bloomberg; Refinitive; authors' calculations.

6 Conclusions

In this paper, we have laid out a model of portfolio choice that captures the key features of original sin redux. The key element is a Value-at-Risk (VaR) constraint for global investors who hold a diversified portfolio of assets in different currencies, but who evaluate gains and losses in dollar terms. A broad-based dollar depreciation then increases the risk capacity of the investors through higher economic capital. One key prediction of the model is that a broad-based dollar depreciation has a larger impact on the local currency bond market of a particular EME than the equivalent change in the bilateral dollar exchange rate. Empirical evidence from using granular data on fund-level purchases of EME local currency bonds and on security-level bond spreads strongly confirms the predictions of the model.

Our analysis provides a building block for the analysis of fluctuations in global financial conditions and for the concept of original sin redux (Carstens and Shin (2019)). It also provides a conceptual foundation for recent evidence documenting that the US dollar has attributes of a global barometer of risk-taking capacity affecting macro-financial conditions in EMEs even when EME borrowers do not have currency mismatches, consistent with the concept of original sin redux.

In this vein, our analysis contributes to the ongoing debate about macro-financial stability frameworks (MFSFs) for EMEs. The bulk of conceptual contributions to this debate are centred on traditional borrower currency mismatches. At the same time, the debate focuses exclusively on defensive measures that can be taken by the EMEs as receiving countries. Our paper shows that, in order to understand the challenges faced by EMEs and the nature of their vulnerability, it is key to also take into account the investor perspective. This means that improving the resilience of EMEs to swings in global liquidity may also require adjustments on the investor side in sending countries. One possible route could be to deepen FX hedging markets that let investors enter the EME bond market on a currency-hedged basis. This could mitigate the amplifying effect of exchange rate movements on bond returns and could also enhance returns by allowing investors to harvest the FX basis in swap markets. Another approach might be to adjust benchmarking and funding practices with a view to mitigating the feedback loop between exchange rate movements, portfolio flows and asset prices, thus enhancing the risk-return trade-off for investors. Alternative investment benchmarks based on risk parity, which base portfolio weights on risk/volatility rather than on market capitalisation like the traditional benchmarks, could also improve diversification and return properties of EME bond portfolios.

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Annex

	(1)	(2)	(3)
	Separate BER	Separate USD	Simple Joint
Bilateral exchange rate (BER)	−0.017***		−0.013*
	(−2.68)		(−1.66)
Dollar Index (USD)		−0.044***	−0.027
		(−3.09)	(−1.65)
N	44281	44281	44281
R-squared	0.025	0.024	0.025

Table 7. **Impact of exchange rate shocks on EME local currency bond purchases using the EME-only dollar index.** This table shows the coefficients on the change in the bilateral US dollar exchange rate and the EME-only dollar index on days of ECB or BOJ monetary policy announcements in a monthly panel regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds (on average 58 monthly observations). A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the EME-only dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses.

	(1)	(2)	(3)
	Separate BER	Separate USD	Simple Joint
Bilateral exchange rate (BER)	−0.017***		−0.005
	(−2.68)		(−0.78)
Dollar Index (USD)		−0.068**	−0.064***
		(−6.12)	(−5.68)
N	44281	44281	44281
R-squared	0.025	0.025	0.025

Table 8. **Impact of exchange rate shocks on EME local currency bond purchases using the AE-only dollar index.** This table shows the coefficients on the change in the bilateral US dollar exchange rate and the AE-only dollar index on days of ECB or BOJ monetary policy announcements in a monthly panel regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds (on average 58 monthly observations). A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the AE-only dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses.

	(1)	(2)	(3)
	Separate BER	Separate USD	Simple Joint
Bilateral exchange rate (BER)	−0.017***		−0.010
	(−2.68)		(−1.52)
Dollar Index (USD)		−0.028***	−0.025***
		(−6.38)	(−5.86)
N	44281	44281	44281
R-squared	0.025	0.025	0.025

Table 9. **Impact of exchange rate shocks on EME local currency bond purchases using the PCA-based dollar index.** This table shows the coefficients on the change in the bilateral US dollar exchange rate and the PCA-based dollar index on days of ECB or BOJ monetary policy announcements in a monthly panel regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds (on average 58 monthly observations). The principal component-weighted US dollar index considers the same list of AEs and EMEs in the broad dollar index but uses country weights calculated from the factor loadings of a principal component analysis of bilateral exchange rates of these countries against the US dollar. A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the PCA-based dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses.

	(1)	(2)	(3)
	Separate BER	Separate USD	Simple Joint
Bilateral exchange rate (BER)	−0.017***		0.000
	(−2.68)		(0.04)
Dollar Index (USD)		−0.053***	−0.053***
		(−5.68)	(−5.32)
N	44281	44281	44281
R-squared	0.025	0.025	0.025

Table 10. **Impact of exchange rate shocks on EME local currency bond purchases using the BIS 10-by-10 dollar index.** This table shows the coefficients on the change in the bilateral US dollar exchange rate and the BIS 10-by-10 dollar index on days of ECB or BOJ monetary policy announcements in a monthly panel regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds (on average 58 monthly observations). The BIS 10-by-10 dollar index is a simple average of ten bilateral exchange rates against the US dollar of five advanced economy currencies (Australian dollar, Canadian dollar, Swiss franc, British pound and euro) and five EME currencies (Brazilian real, Indian rupee, Korean won, Mexican peso and Russian ruble) with 10 percent weight for each currency. A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the BIS 10-by-10 dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses.

	(1)	(2)	(3)
	Separate BER	Separate USD	Simple Joint
Bilateral exchange rate (BER)	−0.017***		−0.000
	(−2.68)		(−0.00)
Dollar Index (USD)		−0.054***	−0.054***
		(−5.62)	(−5.21)
N	44281	44281	44281
R-squared	0.025	0.025	0.025

Table 11. **Impact of exchange rate shocks on EME local currency bond purchases using the BIS financially-weighted dollar index.** This table shows the coefficients on the change in the bilateral US dollar exchange rate and the BIS financially-weighted dollar index on days of ECB or BOJ monetary policy announcements in a monthly panel regressions on local currency bond purchases over the period from January 2011 to June 2020 for 20 EMEs for 55 local currency government bond funds (on average 58 monthly observations). The BIS financially-weighted dollar index is an weighted average of 11 bilateral exchange rates (Australian dollar, Canadian dollar, Swiss franc, British pound, euro, Brazilian real, Chinese yuan, Indian rupee, Korean won, Mexican peso and Russian ruble) against the US dollar, where the weights are the coefficients on the exchange rate variables in the first principal component of 24 financial variables. A negative coefficient means that when the US dollar appreciates against an EME's currency in terms of either the bilateral exchange rate or the BIS financially-weighted dollar index, a bond fund sells the EME's bond. Other explanatory variables include the lagged dependent variable and the control variables (the VIX index, US CPI, US IP, change in the US 3-month money market rate, an EME's CPI, an EME's IP, an EME's 3-month money market rate, all lagged by one month). The coefficients on the lagged dependent variable and the control variables are not reported in this table. t-statistics are in parentheses.

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