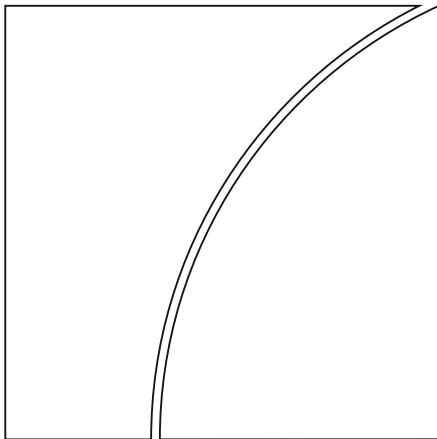




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Monetary and Economic Department

July 2022

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Risk capacity, portfolio choice and exchange rates*

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Abstract

We lay out a model of risk capacity for global portfolio investors in which swings in exchange rates can affect their 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. A currency appreciation for an emerging market borrower that is part of a broad-based appreciation of emerging market currencies leads to larger bond portfolio inflows than the equivalent appreciation in the absence of a broad-based appreciation. As such, the broad dollar index emerges as a global factor in bond portfolio flows. The empirical evidence strongly supports the predictions of the model.

JEL codes: G12, G15, G23.

Keywords: bond spread, capital flow, credit risk, emerging market, exchange rate.

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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 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 re-

fer 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 EM 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, bond spreads and high-frequency exchange rate shocks. 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 introduces 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 be-

tween 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. (2021) 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 gives 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 sheets 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 (2022) 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 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 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.

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

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

The investor's portfolio choice problem is:

$$\text{Maximise}_b \mu' b \quad \text{subject to} \quad \alpha \sqrt{b' \Sigma b} \leq \kappa \quad (3)$$

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:

$$\kappa = c (\mu' b)^\beta \quad (4)$$

where c and β are positive constants such that $c \in (0, 1)$ and $\beta \in (\frac{1}{2}, 1)$. A higher expected return provides a larger cushion to absorb shocks relative to the expected portfolio value. The assumption of $\beta \in (\frac{1}{2}, 1)$ 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

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

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

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

Re-arranging, the optimal portfolio b satisfies:

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

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

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

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

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

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:

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

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

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

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

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

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

$$b = \frac{c (\mu' b)^\beta}{\alpha} \cdot \frac{c (\mu' b)^{\beta-1}}{\alpha} \Sigma^{-1} \mu \quad (11)$$

$$= \left(\frac{c}{\alpha}\right)^2 (\mu' b)^{2\beta-1} \Sigma^{-1} \mu. \quad (12)$$

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 i th 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:

$$p^{t+1} = p^t + \varepsilon^{t+1} \quad (13)$$

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

$$\theta_i^{t+1} = \theta_i^t + \delta^{t+1} + \gamma_i^{t+1} \quad (14)$$

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:

$$\delta^{t+1} = \delta^t + \eta^{t+1} \quad (15)$$

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:

$$E^1(\theta_i^2) = \theta_i^1 + \delta^1 + \gamma_i^1 \quad (16)$$

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

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

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:

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

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

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

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

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

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 $(\mu'b)^{2\beta-1}$. 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 $(\mu'b)^{2\beta-1}$ in (19). The common component δ raises the expected returns on *all* bonds, thereby having a much larger impact on $(\mu'b)^{2\beta-1}$. The interpretation is that a broad appreciation of all currencies raises economic capital, and hence the degree of risk-taking

by the investor. Formally:

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

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

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

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:

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

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 bond flow and bond spread data for a panel of up to 20 EMEs over the period from January 2011 to June 2020. 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 20 EMEs for 55 EME local currency government bond funds (on average 58 monthly observations). This yields more than 46,000 monthly country-fund level observations (Table 1).

3.2 Bond spreads and credit risk premia

Daily data on bond spreads are taken from Bloomberg and Datastream. The analysis is based on sovereign yields and local currency/US dollar cross-currency swap rates at the 5-year maturity. 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* ($s_{i,t}^{LC}$) is defined as the spread between the local currency government bond yield ($y_{i,t}^{LC}$) and the US Treasury yield:

$$s_{i,t}^{LC} = y_{i,t}^{LC} - y_t^{\$} \quad (24)$$

The local currency bond spread is available for 18 EMEs.

The *local currency credit risk premium* ($s_{i,t}^{DS}$), 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 ($y_{i,t}^{CCS}$), 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:

$$s_{i,t}^{DS} = y_{i,t}^{LC} - y_t^{\$} - y_{i,t}^{CCS} \quad (25)$$

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.

Table 1 shows that EME local currency spreads averaged 5 percentage points, with a standard deviation of 3 percentage points reflecting the repeated bouts of volatility in these markets over this period. The local currency risk premium accounts for about a fifth of the sovereign spread, averaging less than one percentage point.

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 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 European Central Bank (ECB) or the Bank of Japan (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 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 shocks¹ to an EME i , $\Delta BER_{i,t}^S$ and ΔUSD_t^S , are then calculated as follows:

$$\Delta BER_{i,t}^S = \begin{cases} \Delta BER_{i,t} & \text{if } t \in N \\ 0 & \text{otherwise} \end{cases} \quad (26)$$

$$\Delta USD_t^S = \begin{cases} \Delta USD_t & \text{if } t \in N \\ 0 & \text{otherwise} \end{cases} \quad (27)$$

where $\Delta BER_{i,t}$ and ΔUSD_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 0.24 per cent, respectively (Table 1). The ratio of the mean and standard deviation of the non-zero BER shocks is around 1.1, while the ratio of the non-zero USD shocks is around 1.

¹We 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.

	Mean	Std. Dev	Observations	Countries
Bond purchase/TNA	0.0176	1.4904	46,482	20
Local currency spread	5.0504	3.1202	44,711	18
Local currency risk premium	0.8738	1.0586	31,674	16
Shocks to 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

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

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 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:

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

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

where $f_{i,j,t}$ denotes the purchases of local currency bonds of country i by bond fund j in percent of net assets of bond fund j . $\Delta BER_{i,t}^S$ and ΔUSD_t^S 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.² The regressions include fund fixed effects³ α_j and the one-month lagged dependent variable.⁴ The coefficient estimates $\hat{\beta}$ and $\hat{\delta}$ 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:

$$f_{i,j,t} = \alpha_j + \rho f_{i,j,t-1} + \beta \Delta BER_{i,t}^S + \delta \Delta USD_t^S + \Gamma Z_{i,t-1} + \eta_{i,j,t} \quad (30)$$

²The results are unaffected by adding the change in the 5-year US Treasury yield as an additional control variable.

³The baseline specification includes fund fixed effects and uses clustered standard errors by fund. 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.

⁴The 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.

Figure 1 plots two combinations of the coefficients on ΔBER^S on ΔUSD^S obtained through these exercises. The coefficient values on the vertical axis show the impact of a 1 percent broad US dollar appreciation shock while those on the horizontal axis that of a 1 percent depreciation shock of an EME's local currency against the US dollar. As mentioned before, an increase in the bilateral exchange rate means appreciation of the US dollar against the EME local currency while an increase in the US dollar index means a broad-based appreciation of the US dollar. Therefore, a negative coefficient means that when the dollar appreciates, an EME bond fund sells EME bonds. Two dots show a pair of coefficients from separate regressions (equations (28) and (29)) and of the joint regression (equation (30)), respectively. The vertical and horizontal line segments around a dot show the +/- two standard error bands for the coefficients on the broad dollar index and the bilateral exchange rate, respectively.

The results of this exercise are summarised in Figure 1, while Table 2 provides more details. They show 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. All the dots in Figure 1 are below the 45 degree line, reflecting that the coefficients on the broad dollar exchange rate are larger than those on the bilateral exchange rate. 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, that is, the two dots are significantly below the 45 degree line. 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 the BIS financially-weighted dollar index.⁵ The Annex provides five graphs showing the

⁵The 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 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% weight

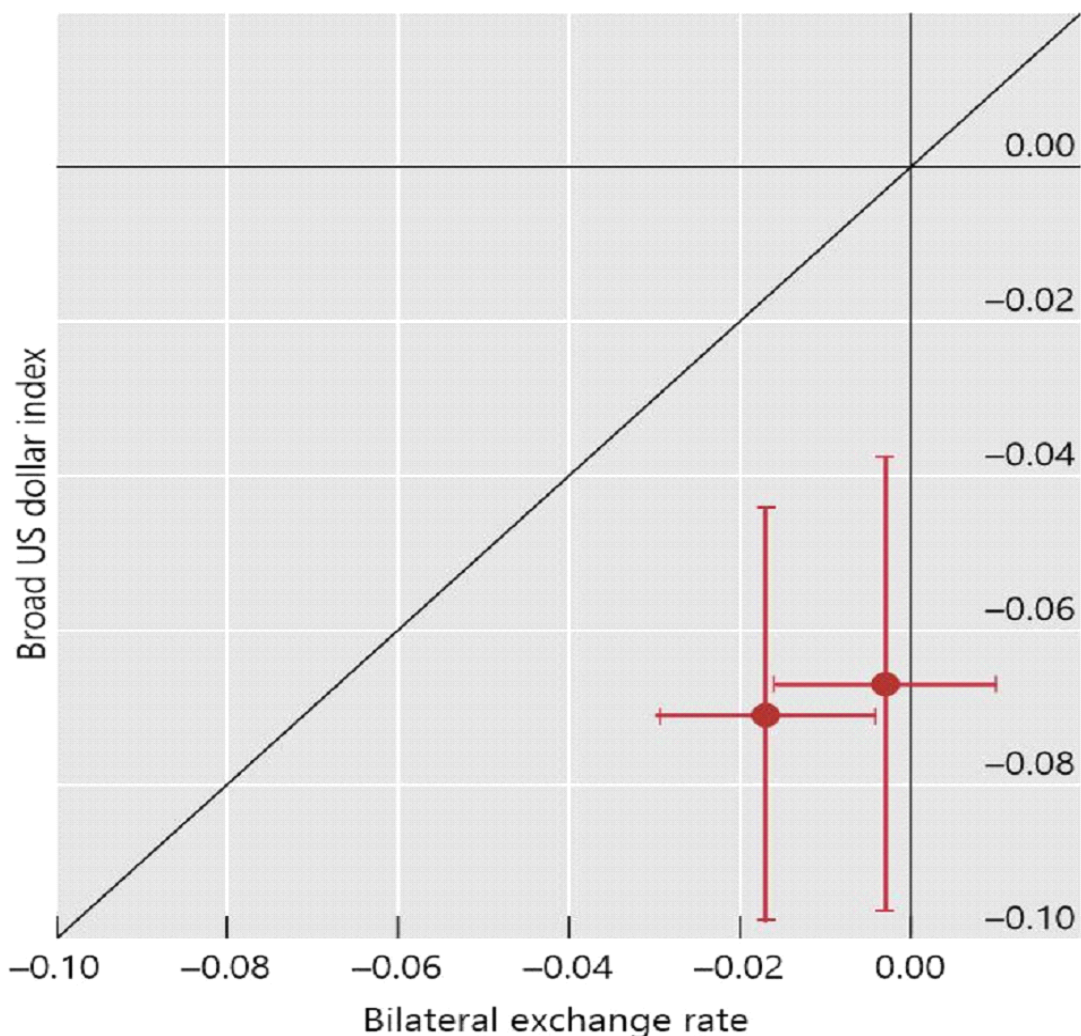


Figure 1. **Impact of exchange rate shocks on EME local currency bond purchases.** The coefficient values on the vertical/horizontal axis show the impact of a 1 percent broad US dollar appreciation shock/bilateral US dollar exchange rate shock (defined as the change in the broad US dollar index/bilateral exchange rate on days of the ECB’s or the Bank of Japan’s monetary policy announcements). 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 negative coefficient means that when the dollar appreciates, an EME bond fund sells EME bonds. The vertical line around a dot shows the +/- two standard error band for the coefficient on the broad dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Two dots show a pair of coefficients from separate regressions and a simple joint regression, respectively. The coefficients are from monthly unbalanced panel regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with the lagged dependent variable and control variables explained in Section 3. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors’ calculations.

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

Table 2. **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.

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.

Figure 1 and Table 2 show 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. Figure 2 shows country codes, each of which represents a pair of the coefficients from separate regressions for each EME. We find that 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.⁶

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.

⁶We also run country-by-country separate regressions for the 20 EMEs and obtain similar but slightly

Moreover, the average value of the country-specific coefficients represented by the red dot in Figure 2 also confirms the results. Again, the vertical and horizontal line segments around a dot show the \pm two standard error bands for the coefficients on the broad dollar index and the bilateral exchange rate, respectively. We find that the coefficient on the broad dollar index is statistically significant and that the coefficient on the broad dollar index is statistically significantly greater than that on the bilateral exchange rate.

5 Exchange rates and EME bond spreads

For the daily 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.⁷

We run *LLP* regressions over horizons up to 30 working days. We regress the change in an EME i 's sovereign bond spreads (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:

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

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

for $h = 1, \dots, 30$. 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 country fixed effects α_i and a lagged dependent variable.⁸ 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

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.

⁷Plagborg-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.

⁸The 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

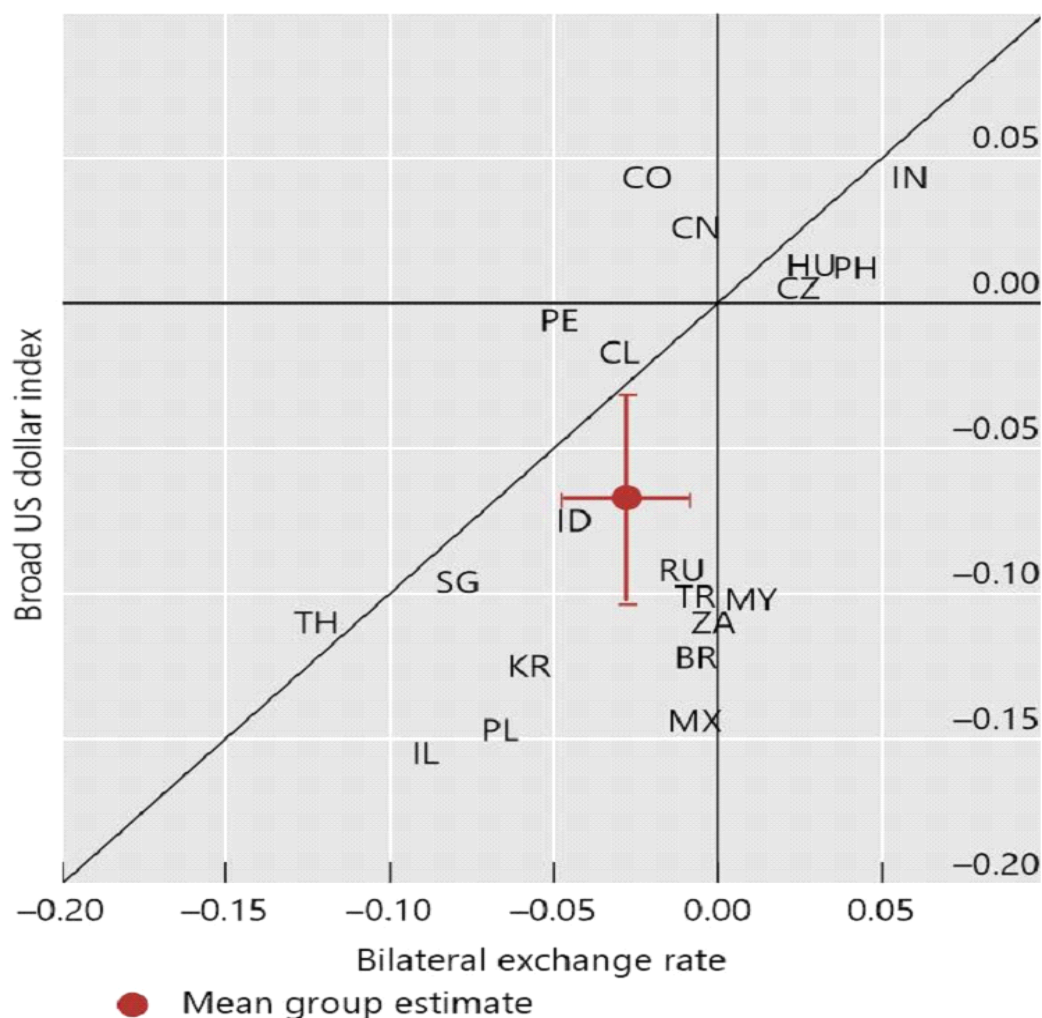


Figure 2. **Impact of exchange rate shocks on EME local currency bond purchases for individual EMEs.** The coefficient values on the vertical/horizontal axis show the impact of a 1 percent broad US dollar appreciation shock/bilateral US dollar exchange rate shock (defined as the change in the broad US dollar index/bilateral exchange rate on days of the ECB’s or the Bank of Japan’s monetary policy announcements). 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 negative coefficient means that when the dollar appreciates, an EME bond fund sells an EME’s bonds. Each country code shows a pair of coefficients. The coefficients are from monthly mean group separate regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with country-specific coefficients on the exchange rate shocks, the lagged dependent variable and control variables explained in Section 3. The average value of the country-specific coefficients is represented by the red dot. The vertical line around a dot shows the +/- two standard error band for the coefficient on the broad dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors’ calculations.

the error term. The series of coefficient estimates $\widehat{\beta}_1, \dots, \widehat{\beta}_{30}$ and $\widehat{\delta}_1, \dots, \widehat{\delta}_{30}$ 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:

$$s_{i,t+h} - s_{i,t-1} = \alpha_{h,i} + \rho_h(L)\Delta s_{i,t-1} + \beta_h \Delta BER_{i,t}^S + \delta_h \Delta USD_t^S + \Gamma_h Z_{i,t-1} + \eta_{i,t+h} \quad (33)$$

Figures 3 and 4 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 3 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 four times as strong at the peak, at 20 basis points (top-right panel). The effects are qualitatively and quantitatively similar when both shocks are included simultaneously (bottom panels).

Figure 4 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 very similar to that on the local currency spread. Also here, the impact of an appreciation of the dollar index is considerably larger than that of the bilateral dollar exchange rate. 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 3 and 4 show the average effect of the two dollar exchange rates on the local currency bond spread across 18 EMEs and on the Du-Schreger spread across 16 EMEs. In order to gauge the impact of the two dollar exchange rates for individual EMEs, we conduct mean group separate *LLP* regressions in which we estimate country-specific

assumption is validated by the fact that the results are virtually identical when we re-run the regressions with the lagged dependent variable excluded.

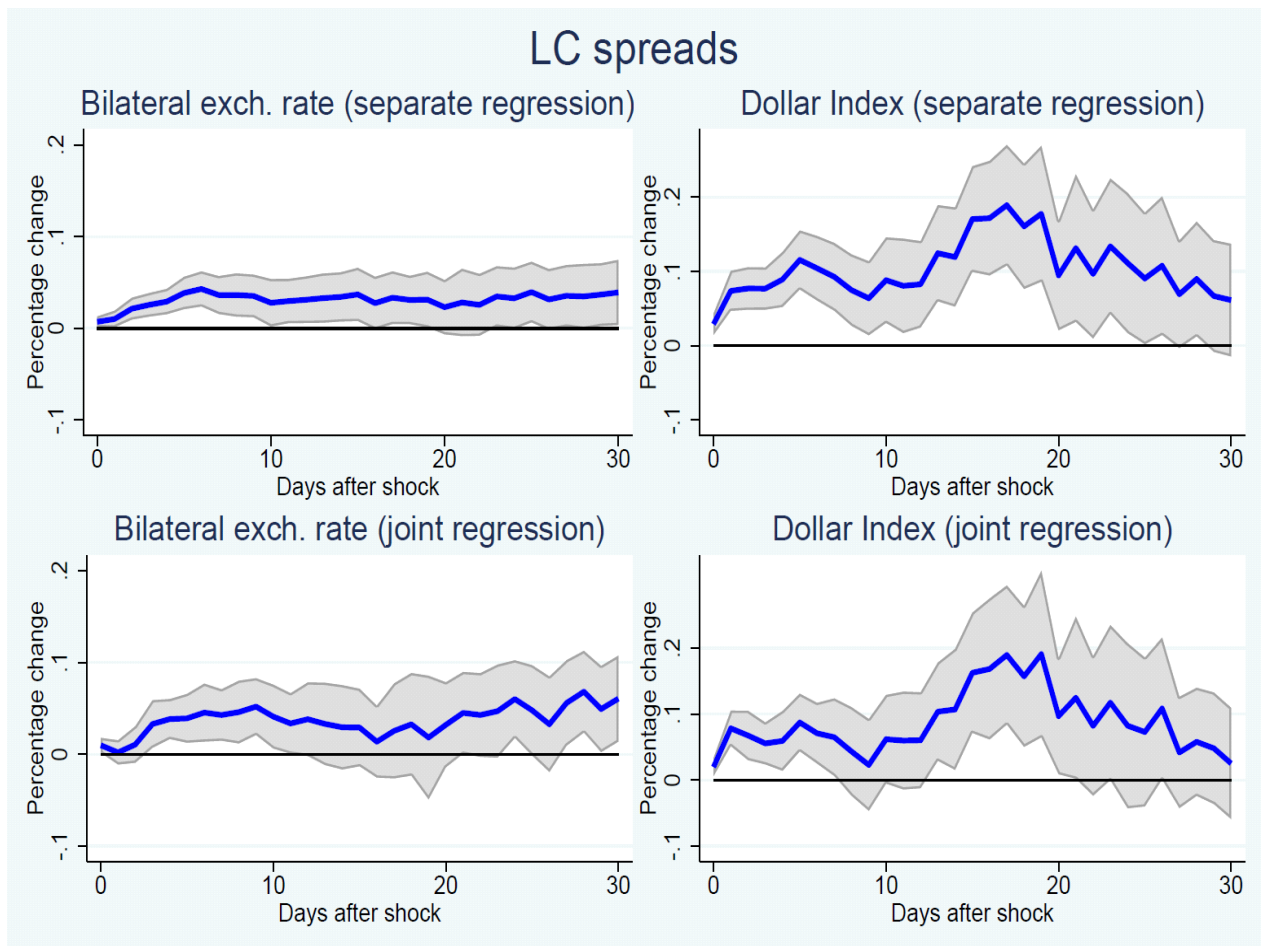


Figure 3. **Impact of US dollar appreciation shocks on EME local currency bond spreads.** The figure shows the impact of a 1 percent appreciation shock (log exchange rate changes on days of euro area and Japanese monetary policy news) to the bilateral exchange rate against the US dollar and to the broad dollar index. The 90% confidence bands are based on heteroskedasticity and autocorrelation robust standard errors. Sources: Bloomberg; JPMorgan Chase; authors' calculations.

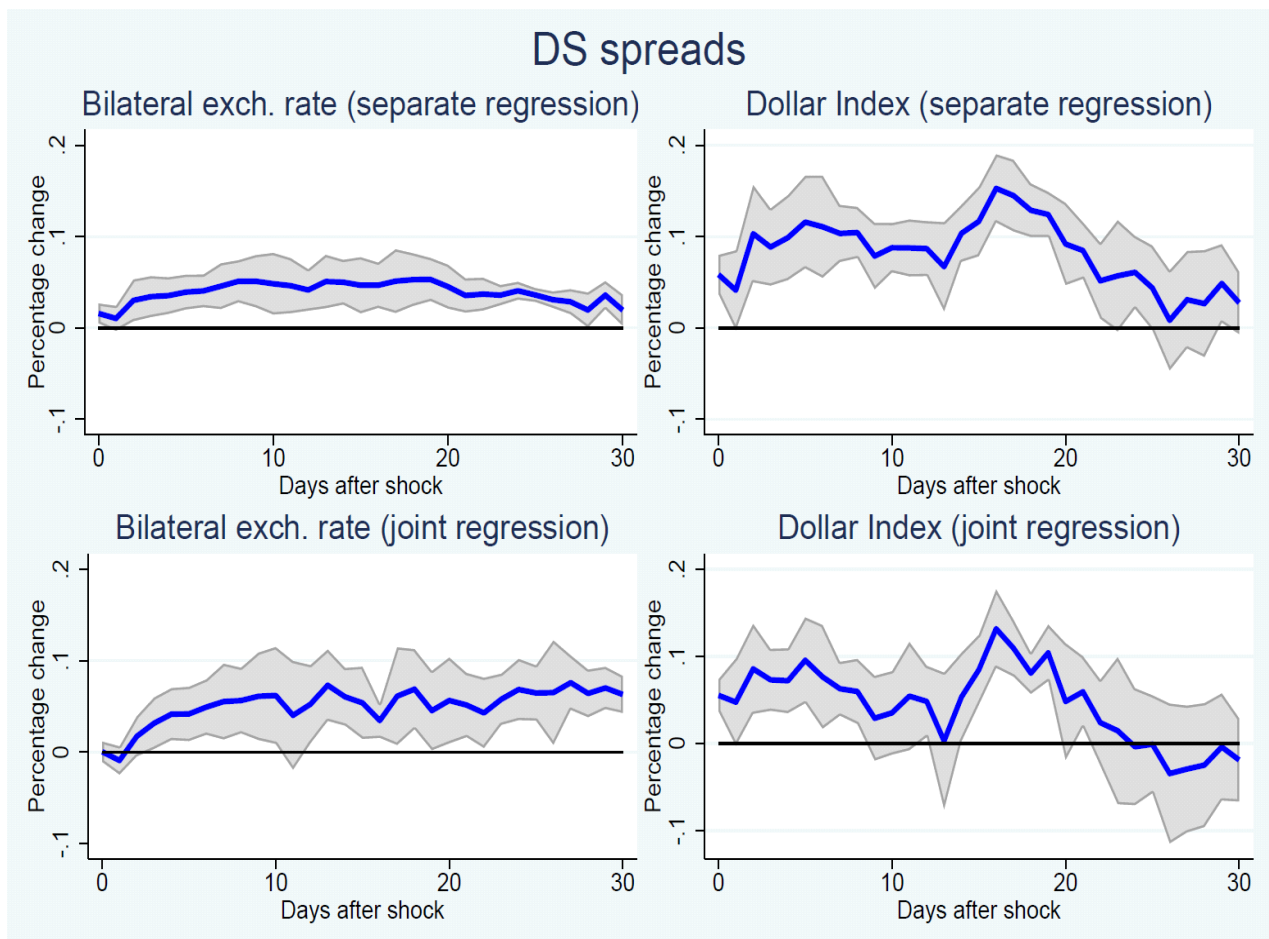


Figure 4. **Impact of US dollar appreciation shocks on EME local currency credit risk spreads for all EMEs.** The figure shows the impact of a 1 percent appreciation shock (log exchange rate changes on days of euro area and Japanese monetary policy news) to the bilateral exchange rate against the US 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.

coefficients on either of the two dollar exchange rates over the 30-day horizon. Figure 5 shows country codes, each of which represents a pair of the coefficients showing the impact over the 30-day horizon from separate regressions on the local currency bond spread for each of the 18 EMEs, while Figure 6 shows country codes, each of which represents a pair of the coefficients showing the impact from separate regressions on the Du-Schreger spread for each of the 16 EMEs. From Figure 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 18 EMEs, while the coefficient on the broad dollar index is very close to that on the bilateral dollar exchange rate for the other two EMEs. From Figure 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 14 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 the other two EMEs.⁹ Finally, the average value of the country-specific coefficients represented by the red dot in Figures 5 and 6 also confirms the results.¹⁰

⁹We 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.

¹⁰The +/- two standard error bands for the coefficients on the broad dollar index and the bilateral exchange rate are, respectively, very narrow. Therefore, they are not visible in Figures 5 and 6. This is because 30 out of 36 coefficients for 18 EMEs shown in Figure 5 are statistically significant, while 31 out of 32 coefficients for 16 EMEs shown in Figure 6 are statistically significant. The country-specific peak impact coefficients are available upon request.

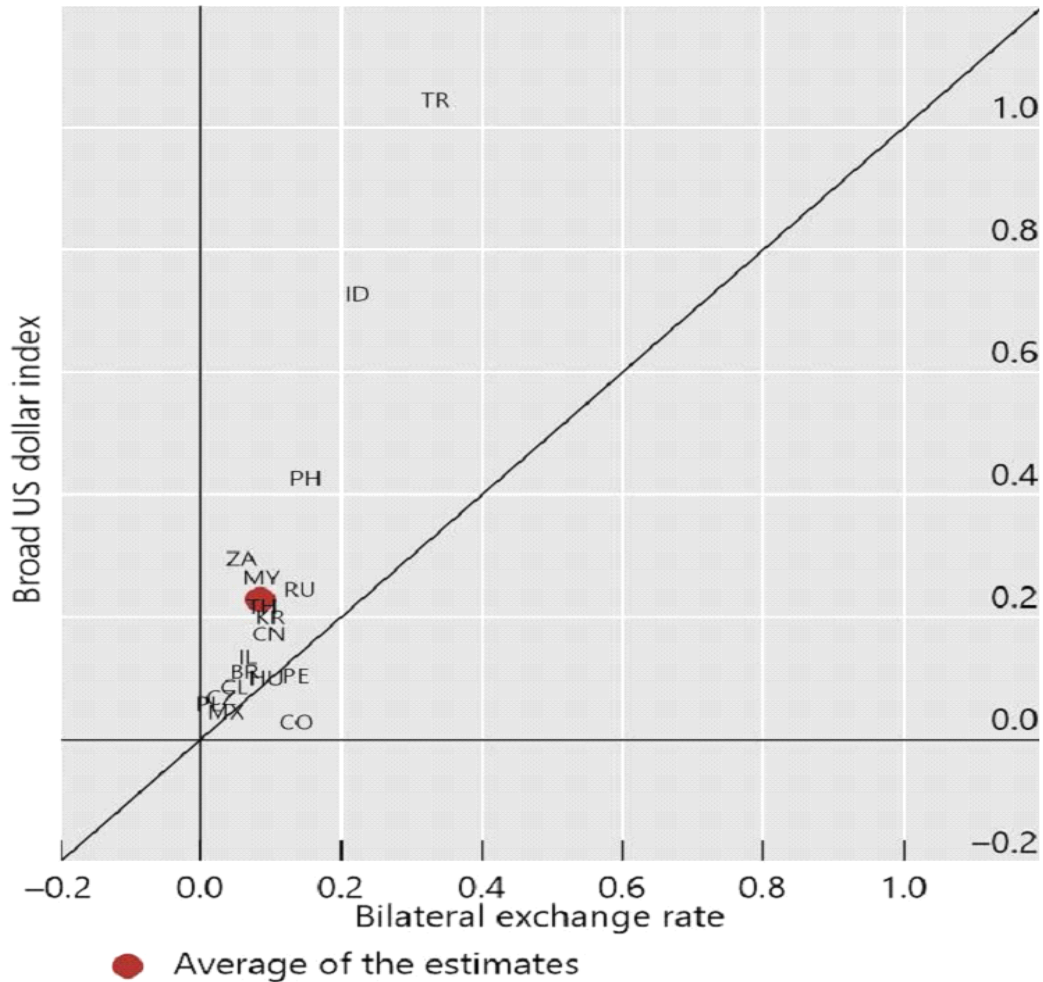


Figure 5. **Peak impact of exchange rate shocks on EME local currency bond spread for individual EMEs.** The coefficient values on the vertical/horizontal axis show the peak impact of a 1 percent broad US dollar appreciation shock/bilateral US dollar exchange rate shock (defined as the change in the broad US dollar index/bilateral exchange rate on days of the ECB’s or the Bank of Japan’s 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. Each country code shows a pair of the coefficients. The coefficients are from daily mean group separate regressions for 18 EMEs from January 2011 to June 2020 with country-specific coefficients on the exchange rate shocks, the lagged dependent variable and control variables explained in Section 5. Sources: Bloomberg; JPMorgan Chase; authors’ calculations.

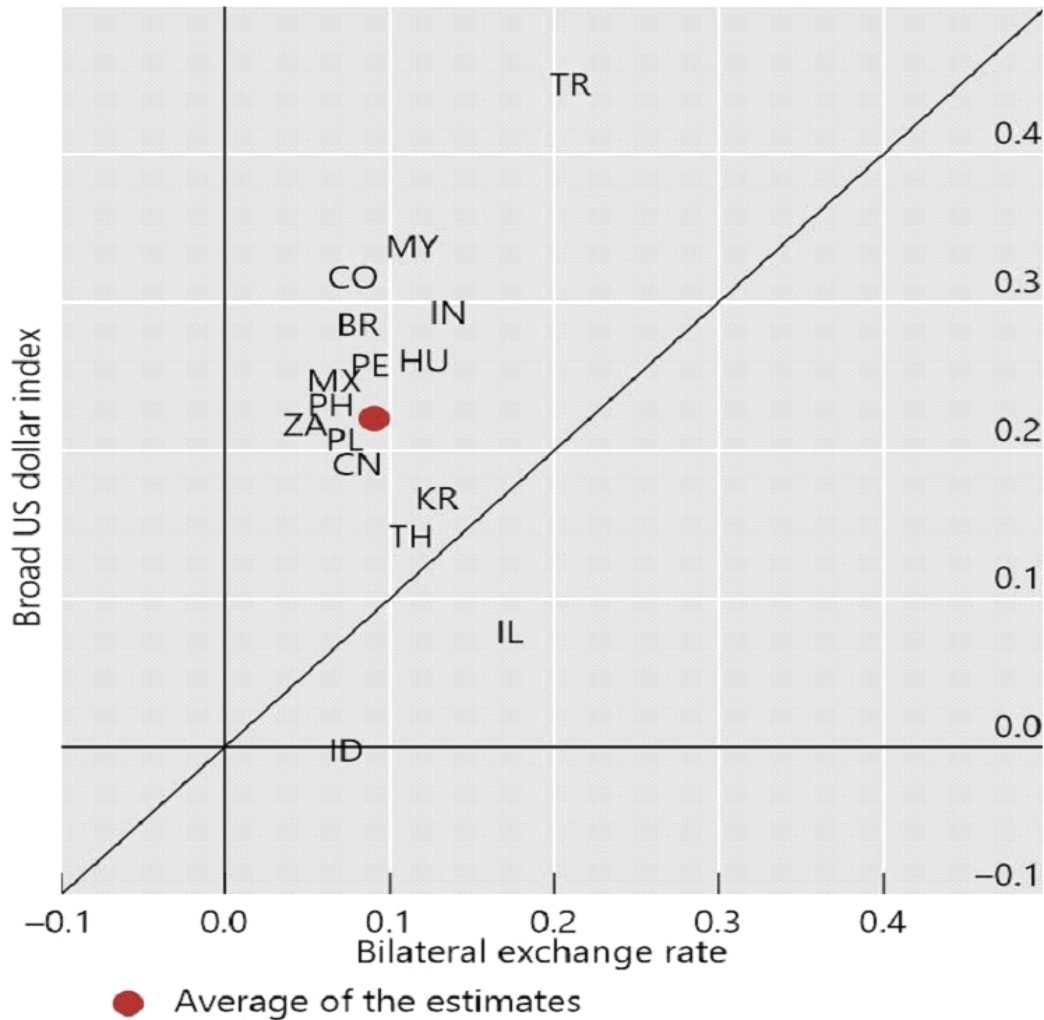


Figure 6. **Peak impact of exchange rate shocks on EME local currency credit risk spread for individual EMEs.** The coefficient values on the vertical/horizontal axis show the peak impact of a 1 percent broad US dollar appreciation shock/bilateral US dollar exchange rate shock (defined as the change in the broad US dollar index/bilateral exchange rate on days of the ECB’s or the Bank of Japan’s monetary policy announcements) over the 30-day horizon. An increase in the bilateral exchange rate means an appreciation of the US dollar and thus a depreciation of the EME currency. An increase in the US dollar index means the appreciation of the US dollar broadly. Therefore, a positive coefficient means that when the dollar appreciates, an EME’s local currency credit spread increases. Each country code shows a pair of the coefficients. The coefficients are from daily mean group separate regressions for 16 EMEs from January 2011 to June 2020 with country-specific coefficients on the exchange rate shocks, the lagged dependent variable and control variables explained in Section 5. Sources: Bloomberg; JPMorgan Chase; 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 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 strongly confirms the predictions of the model.

Our analysis provides a building block for the analysis of the 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 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.

References

- Adrian, Tobias, Christopher J Erceg, Jesper Lindé, Pawel Zabczyk, and Jianping Zhou (2020): “A quantitative model for the integrated policy framework”, *IMF Working Papers*, no 20/122.
- Avdjiev, Stefan, Wenxin Du, Catherine Koch and Hyun Song Shin (2019a): “The dollar, bank leverage and deviation from covered interest parity”, *American Economic Review: Insights*, vol 1(2), pp 193–208.
- Avdjiev, Stefan, Valentina Bruno, Catherine Koch and Hyun Song Shin (2019b): “The dollar exchange rate as a global risk factor: evidence from investment”, *IMF Economic Review*, vol 67, pp 151–173.
- Bank for International Settlements (BIS) (2019): “Monetary policy frameworks in EMEs: inflation targeting, the exchange rate and financial stability”, Chapter II, Annual Economic Report 2019, June.
- Basu, Suman, Emine Boz, Gita Gopinath, Francisco Roch and Filiz Unsal (2020): “A conceptual model for the integrated policy framework”, *IMF Working Paper*, no. 20/121.
- Bertaut, Carol, Valentina Bruno and Hyun Song Shin (2021): “Original sin redux”, Working Paper, available on SSRN.
- Bruno, Valentina and Hyun Song Shin (2015a): “Cross-border banking and global liquidity”, *Review of Economic Studies*, vol 82(2), pp 535–564.
- Bruno, Valentina and Hyun Song Shin (2015b): “Capital flows and the risk-taking channel of monetary policy”, *Journal of Monetary Economics*, vol 71, pp 119–132.
- Bruno, Valentina, Ilhyock Shim and Hyun Song Shin (2022): “Dollar beta and stock returns”, *Oxford Open Economics*, vol 1, odac003, pp 1–10.
- Carstens, Agustín and Hyun Song Shin (2019): “Emerging market economies and global financial conditions: “Original Sin” redux”, *Foreign Affairs*, 15 March 2019.
- Céspedes, Luis Felipe, Roberto Chang and Andres Velasco (2004): “Balance sheets and exchange rate policy”, *American Economic Review*, vol 94(4), pp 1183–1193.
- Devereux, Michael B. and Steve Pak Yeung Wu (2022): “Foreign reserve management and original sin”, manuscript.
- Du, Wenxin and Jesse Schreger (2016): “Local currency sovereign risk”, *Journal of Finance*, vol 71(3), pp 1027–1069.
- Eichengreen, Barry and Ricardo Hausmann (1999): “Exchange rates and financial fragility”, Proceedings of the Economic Policy Symposium “New Challenges for Monetary Policy” in Jackson Hole, Federal Reserve of Kansas City, pp 319–67.

Engel, Charles and Steve Pak Yeung Wu (2018): “Liquidity and exchange rates: an empirical investigation”, *NBER Working Paper*, no 25397.

Ferrari, Massimo, Jonathan Kearns and Andreas Schrimpf (2017): “Monetary policy’s rising FX impact in the era of ultra-low rates”, *BIS Working Papers*, no 626.

Gabaix, Xavier and Matteo Maggiori (2015): “International liquidity and exchange rate dynamics”, *The Quarterly Journal of Economics*, vol 130(3), pp 1369–1420.

Gilchrist, Simon, Bin Wei, Vivian Yue and Egon Zakrajsek (2022): “Sovereign risk and financial risk”, *Journal of International Economics*, vol 136, May.

Hofmann, Boris and Taejin Park (2020): “The broad dollar exchange rate as an EME risk factor”, *BIS Quarterly Review*, December.

Hofmann, Boris, Ilhyock Shim and Hyun Song Shin (2020): “Bond risk premia and the exchange rate”, *Journal of Money, Credit and Banking*, vol. 52(S2), pp 497–520.

Hofmann, Boris, Nikhil Patel, and Steve Pak Yeung Wu (2022): “Original sin redux: a model-based evaluation”, *BIS Working Papers*, no 1004.

Jordà, Òscar (2005), “Estimation and inference of impulse responses by local projections”, *American Economic Review*, vol 95(1), pp 161–182.

Krugman, Paul (1999): “Balance sheets, the transfer problem and financial crises”, in P. Isard, A. Razin, and A. K. Rose (eds.), *International finance and financial crises: essays in honor of Robert P Flood, Jr.* Boston: Kluwer Academic, pp 31–44.

Lee, Annie Soyeon (2022): “Why do emerging economies borrow in foreign currency? The role of exchange rate risk”, Working Paper, University of Wisconsin.

Shousha, S (2019): “The dollar and emerging market economies: financial vulnerabilities meet the international trade system”, Board of Governors of the Federal Reserve System, *International Finance Discussion Papers*, no 1258, October.

Nickell, Stephen (1981): “Biases in dynamic models with fixed effects”, *Econometrica*, vol 49(6), pp 1417–1426.

Plagborg-Møller, Mikkel and Christian K. Wolf (2021): “Local projections and VARs estimate the same impulse responses”, *Econometrica*, vol 89(2), pp 955–980.

Shek, Jimmy, Ilhyock Shim and Hyun Song Shin (2018): “Investor redemptions and fund manager sales of emerging market bonds: how are they related?” *Review of Finance*, vol 22(1), pp 207–41.

Annex

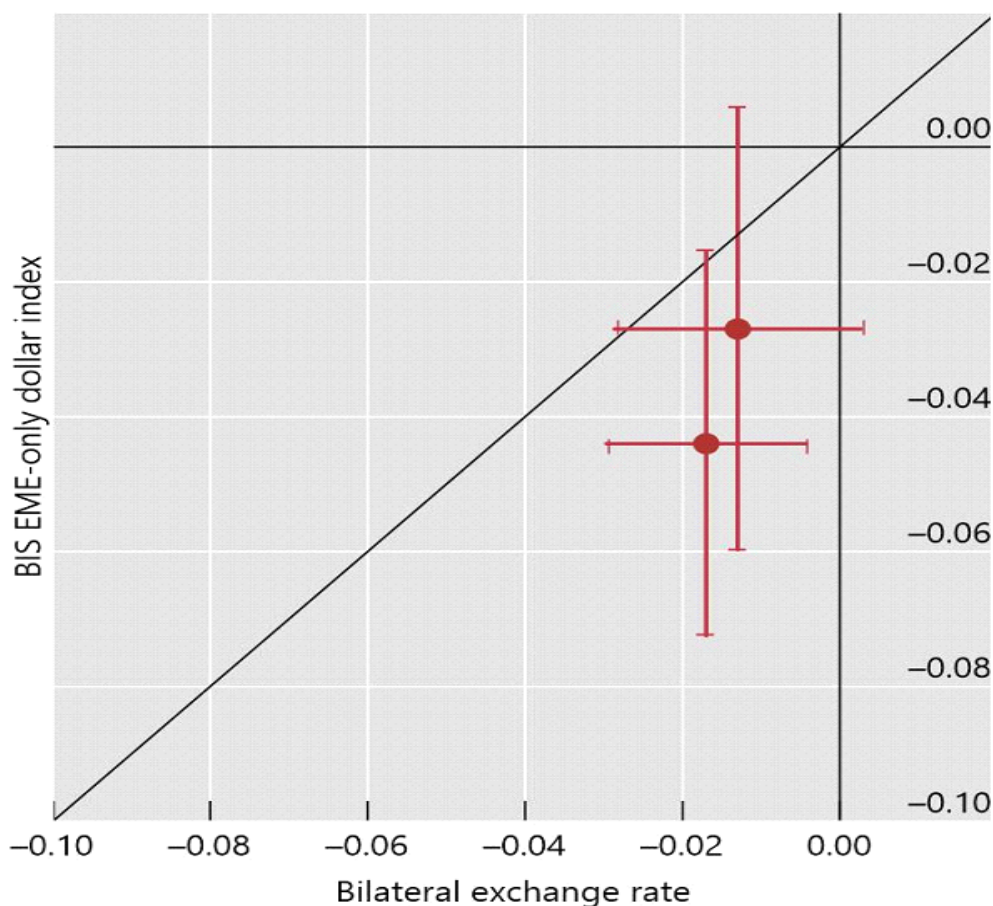


Figure 7. **Impact of exchange rate shocks on EME local currency bond purchases using the EME-only dollar index.** The BIS EME-only US dollar index is an weighted average of the US dollar bilateral exchange rates EMEs in the BIS broad US dollar index. An increase in the bilateral exchange rate is a depreciation of an EME local currency against the US dollar. An increase in the EME-only US dollar index is an appreciation of the US dollar and thus a depreciation of an EME local currency. Therefore, a negative coefficient means that when an EME’s local currency appreciates, an EME bond fund purchases EME bonds. The vertical line around a dot shows the +/- two standard error band for the coefficient on the dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Two dots show a pair of coefficients from separate regressions and a simple joint regression, respectively. The coefficient values on the vertical axis show the impact of a 1 percent EME-only US dollar index appreciation shock (defined as the change in the EME-only US dollar index on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements) on the amount of purchase of an economy’s local currency government bonds (net of FX and local currency bond price changes) by a bond fund divided by total net assets of the bond fund. The coefficient values on the horizontal axis show the impact of a 1 percent bilateral US dollar exchange rate appreciation shock (defined as the change in the bilateral US dollar exchange rate against an EME currency on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements). The coefficients are from monthly unbalanced panel regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with the lagged dependent variable and control variables explained in Section 3. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors’ calculations.

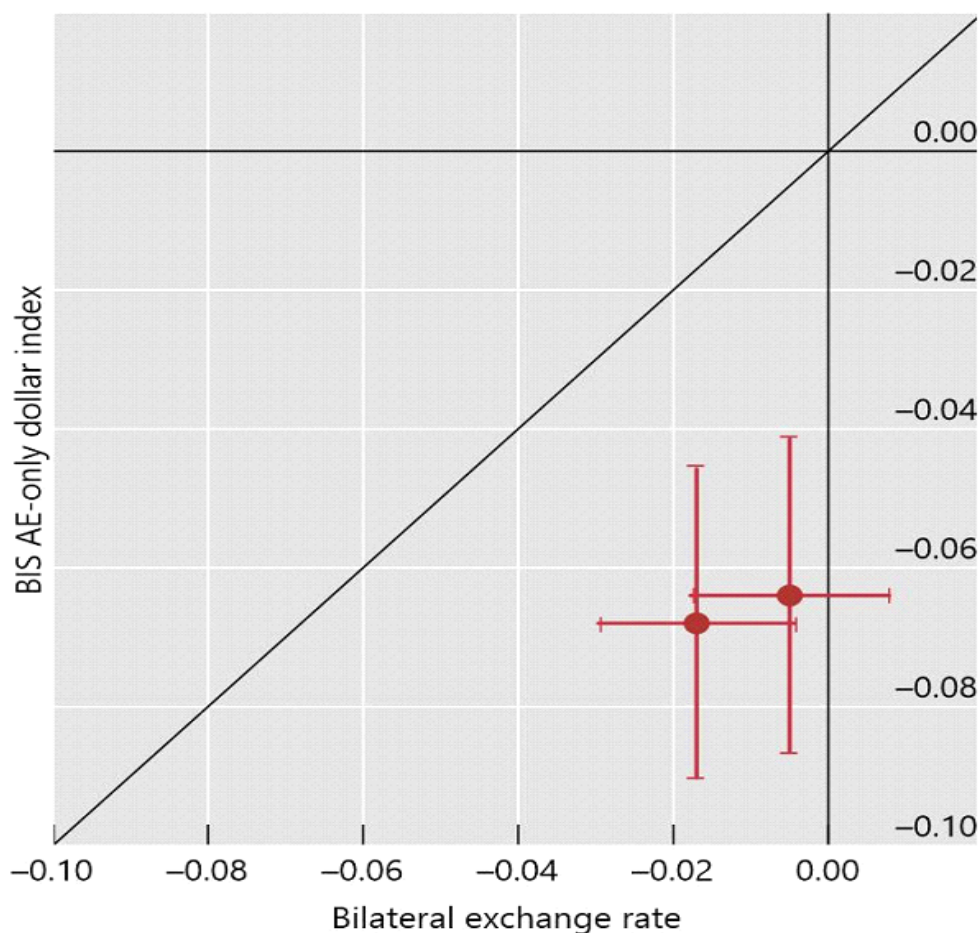


Figure 8. **Impact of exchange rate shocks on EME local currency bond purchases using the AE-only dollar index.** The BIS AE-only US dollar index is a weighted average of the US dollar bilateral exchange rates of advanced economies (AEs) in the BIS broad US dollar index. An increase in the bilateral exchange rate is a depreciation of an EME local currency against the US dollar. Therefore, a negative coefficient means that when an EME’s local currency appreciates, an EME bond fund purchases EME bonds. An increase in the AE-only US dollar index is an appreciation of the US dollar and thus a depreciation of an AE local currency. To the extent that AE currencies and EME currencies weaken together when the US dollar strengthens, a negative coefficient means that when an EME’s local currency appreciates, bond funds purchase EME bonds. The vertical line around a dot shows the +/- two standard error band for the coefficient on the dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Two dots show a pair of coefficients from separate regressions and a simple joint regression, respectively. The coefficient values on the vertical axis show the impact of a 1 percent AE-only US dollar index appreciation shock (defined as the change in the index on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements) on the amount of purchase of an economy’s local currency government bonds (net of FX and local currency bond price changes) by a bond fund divided by total net assets of the bond fund. The coefficient values on the horizontal axis show the impact of a 1 percent bilateral US dollar exchange rate appreciation shock (defined as the change in the bilateral US dollar exchange rate against an EME currency on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements). The coefficients are from monthly unbalanced panel regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with the lagged dependent variable and control variables explained in Section 3. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors’ calculations.

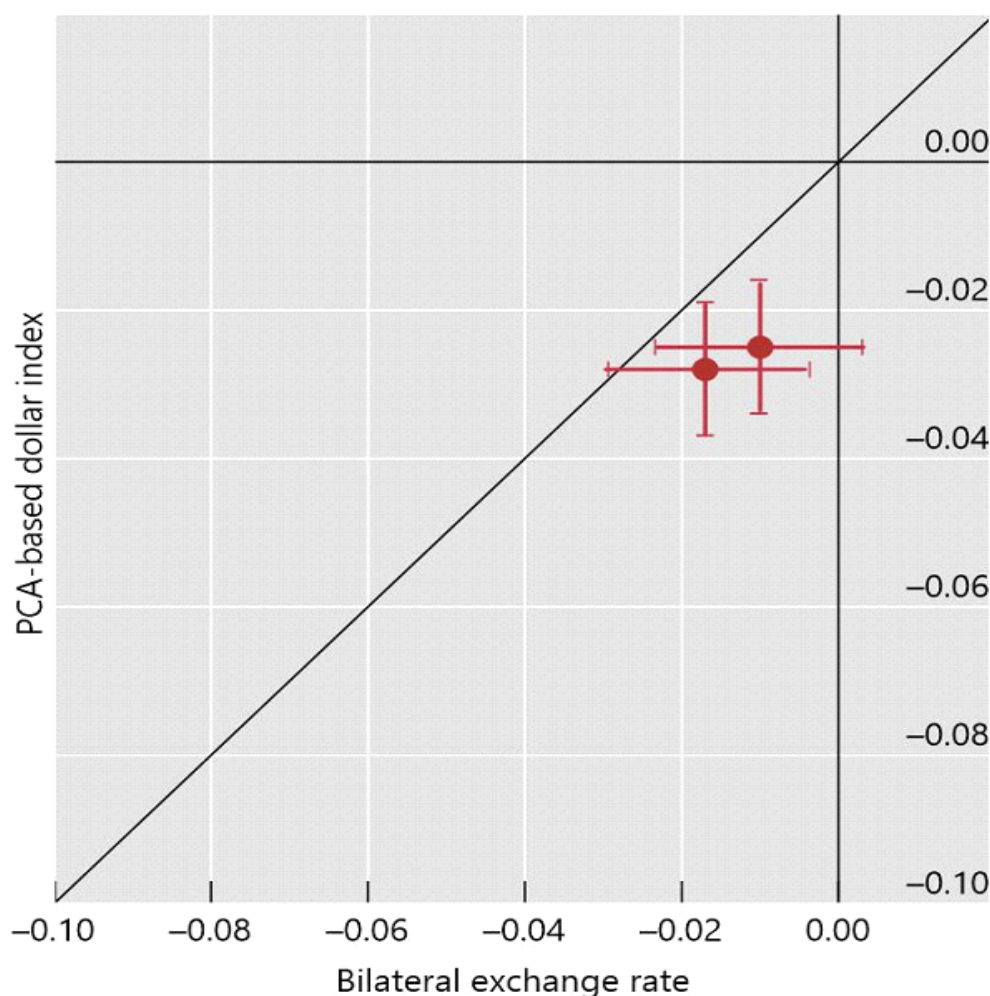


Figure 9. **Impact of exchange rate shocks on EME local currency bond purchases using the PCA-based dollar index.** The BIS PCA-based US dollar index is an weighted average of the US dollar bilateral exchange rates of 40 advanced economies and emerging market economies, in which the factor loadings from a principal component analysis is used to calculate country weights in the dollar index. An increase in the bilateral exchange rate is a depreciation of an EME local currency against the US dollar. An increase in the PCA-based US dollar index is an appreciation of the US dollar and thus a depreciation of an EME local currency. Therefore, a negative coefficient means that when an EME’s local currency appreciates, an EME bond fund purchases EME bonds. The vertical line around a dot shows the +/- two standard error band for the coefficient on the dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Two dots show a pair of coefficients from separate regressions and a simple joint regression, respectively. The coefficient values on the vertical axis show the impact of a 1 percent PCA-based US dollar index appreciation shock (defined as the change in the US dollar index on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements) on the amount of purchase of an economy’s local currency government bonds (net of FX and local currency bond price changes) by a bond fund divided by total net assets of the bond fund. The coefficient values on the horizontal axis show the impact of a 1 percent bilateral US dollar exchange rate appreciation shock (defined as the change in the bilateral US dollar exchange rate against an EME currency on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements). The coefficients are from monthly unbalanced panel regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with the lagged dependent variable and control variables explained in Section 3. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors’ calculations.

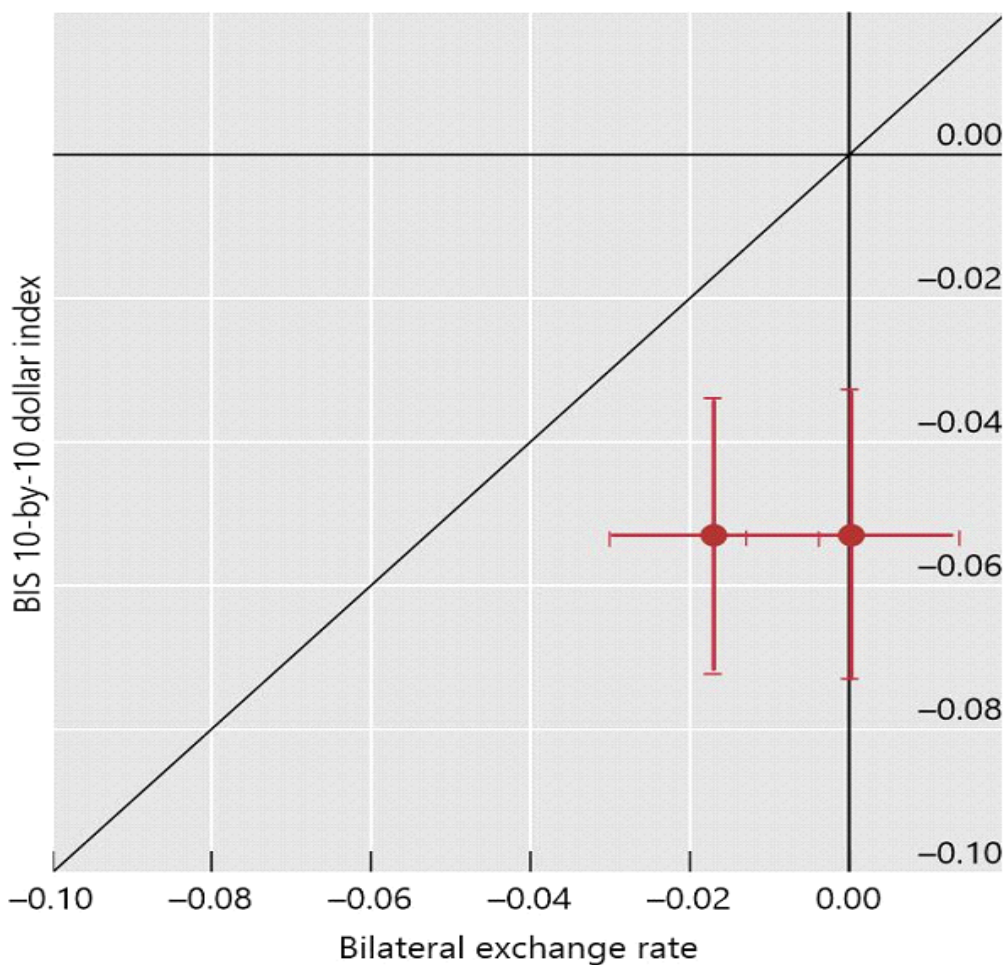


Figure 10. **Impact of exchange rate shocks on EME local currency bond purchases using the BIS 10-by-10 dollar index.** The BIS 10-by-10 US dollar index is a simple average of ten bilateral exchange rates against the US dollar of five advanced economy currencies (Australian dollar, Canadian dollar, Swiss franc, the British pound and the euro) and five EME currencies (Brazilian real, Indian rupee, Korean won, Mexican peso and Russian ruble) with 10% weight for each currency. An increase in the bilateral exchange rate is a depreciation of an EME local currency against the US dollar. An increase in the BIS 10-by-10 US dollar index is an appreciation of the US dollar and thus a depreciation of an EME local currency. Therefore, a negative coefficient means that when an EME’s local currency appreciates, an EME bond fund purchases EME bonds. The vertical line around a dot shows the +/- two standard error band for the coefficient on the dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Two dots show a pair of coefficients from separate regressions and a simple joint regression, respectively. The coefficient values on the vertical axis show the impact of a 1 percent BIS 10-by-10 US dollar index appreciation shock (defined as the change in the US dollar index on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements) on the amount of purchase of an economy’s local currency government bonds (net of FX and local currency bond price changes) by a bond fund divided by total net assets of the bond fund. The coefficient values on the horizontal axis show the impact of a 1 percent bilateral US dollar exchange rate appreciation shock (defined as the change in the bilateral US dollar exchange rate against an EME currency on days of the European Central Bank’s or the Bank of Japan’s monetary policy announcements). The coefficients are from monthly unbalanced panel regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with the lagged dependent variable and control variables explained in Section 3. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors’ calculations.

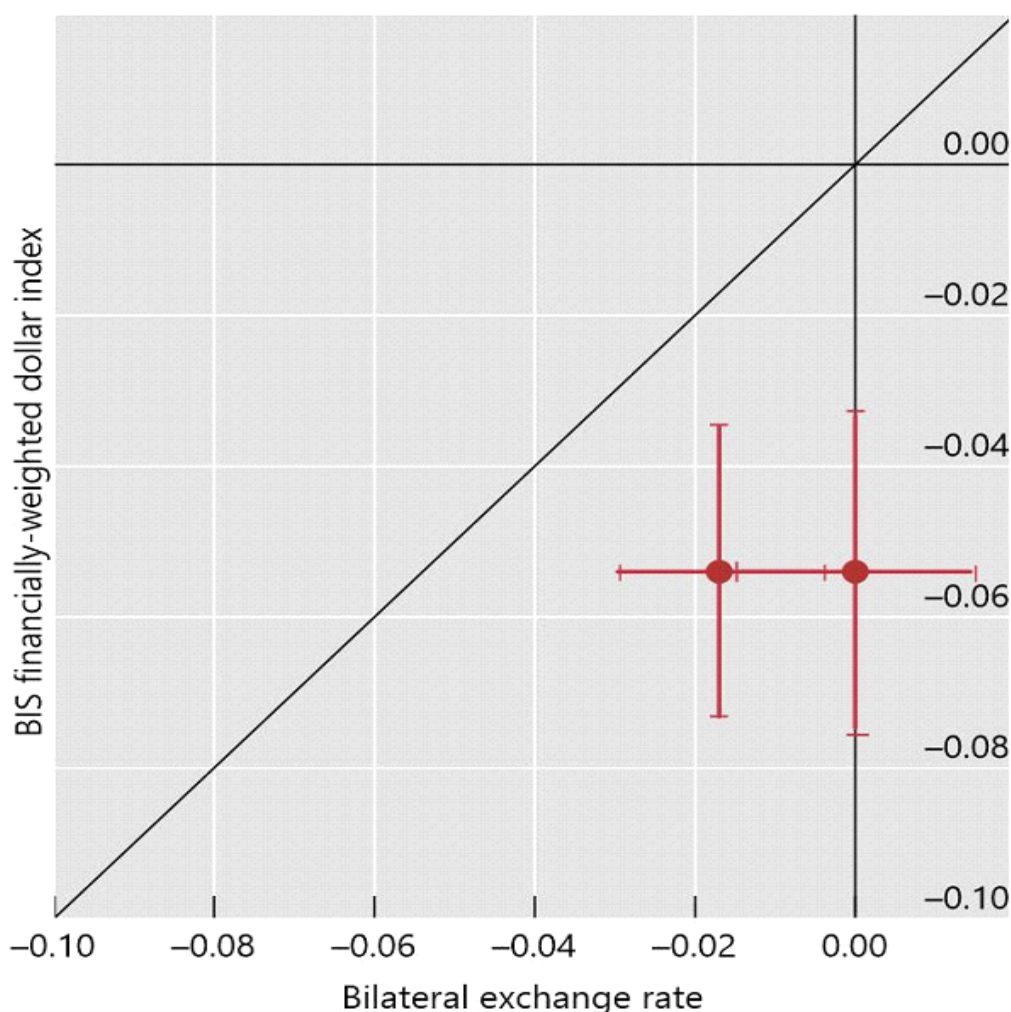


Figure 11. **Impact of exchange rate shocks on EME local currency bond purchases using the BIS financially-weighted dollar index.** The BIS financially-weighted US dollar index is an weighted average of 11 bilateral exchange rates (AUD, CAD, CHP, GBP, EUR, BRL, CNY, INR, KRW, MXN and RUB) against the US dollar, where the weights are the coefficients on the exchange rate variables in the first principal component of 24 financial variables. An increase in the bilateral exchange rate is a depreciation of an EME local currency against the US dollar. An increase in the BIS financially-weighted US dollar index is an appreciation of the US dollar and thus a depreciation of an EME local currency. Therefore, a negative coefficient means that when an EME's local currency appreciates, an EME bond fund purchases EME bonds. The vertical line around a dot shows the +/- two standard error band for the coefficient on the dollar index. The horizontal line around a dot shows the +/- two standard error band for the coefficient on the bilateral exchange rate. Two dots show a pair of coefficients from separate regressions and a simple joint regression, respectively. The coefficient values on the vertical axis show the impact of a 1 percent BIS financially-weighted US dollar index appreciation shock (defined as the change in the US dollar index on days of the European Central Bank's or the Bank of Japan's monetary policy announcements) on the amount of purchase of an economy's local currency government bonds (net of FX and local currency bond price changes) by a bond fund divided by total net assets of the bond fund. The coefficient values on the horizontal axis show the impact of a 1 percent bilateral US dollar exchange rate appreciation shock (defined as the change in the bilateral US dollar exchange rate against an EME currency on days of the European Central Bank's or the Bank of Japan's monetary policy announcements). The coefficients are from monthly unbalanced panel regressions using a sample of 55 global/regional EME local currency government bond funds investing in 20 EMEs from January 2011 to June 2020 with the lagged dependent variable and control variables explained in Section 3. Sources: Bloomberg; EPFR; JPMorgan Chase; national data; authors' calculations.

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