Which Exchange Rates Matter to Global Investors? Evidence from Euro Area Sovereign Bond Holdings*

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Abstract

We examine how global investors react to different types of exchange rates, using security-level holdings of advanced and emerging market sovereign bonds. Our focus on euro-based investors allows us to identify the currency mismatch channel on lenders' balance sheets as separate from other financial channels centered on the US dollar. Euro-based investors systematically shed local currency bonds after a depreciation of these currencies against the euro, while retaining foreign currency bonds of the same sovereign issuers. For better identification, we exploit variation across investors' sovereign exposures and show that lender-specific currency exposures better explain movements in portfolio holdings than an overall depreciation against the euro. Our findings are consistent with a standard portfolio choice problem that incorporates the currency dimensions relevant for global investors holding local and foreign sovereign bonds.

Keywords: currency mismatch, balance sheet effects, emerging markets, exchange rates, institutional investors, sovereign bonds.
JEL classifications: F31, G11, G15, G23.

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I. Introduction

Exchange rates are a key factor in the volatility of capital flows. Most countries borrow abroad in a major currency, primarily the US dollar. This exposes the borrowers to growing debt burdens when their currency depreciates. The risks are well-known, having played out in many crises since the 1980s. The alternative is for countries to borrow abroad in their own currency. While hailed as a solution for borrowers, it exposes the lenders to currency mismatches. How currency risk affects lender behavior has been much less prominent in the literature.

This paper examines how global investors adjust their bond holdings in response to different types of exchange rates. Among the many indices and bilateral rates against the dollar and other currencies, which exchange rates move foreign investment, and why? Our novel angle is to focus on euro-based investors for identification. By rotating the reference currency away from the dollar, we can identify how investors react to exchange rates referencing the euro without the confounding effects arising from the dominant role of the dollar in global finance and trade invoicing (Gopinath et al. (2020)).

Our main contribution is to show that euro area investors systematically shed local currency bonds after a depreciation of these currencies against the euro, while retaining foreign currency bonds of the same sovereign issuers. Thus, we show that an important channel that drives foreign investment is a currency mismatch on the *lender* side. These findings are consistent with a standard portfolio choice problem that incorporates the currency dimensions relevant for global investors holding local and foreign bonds.

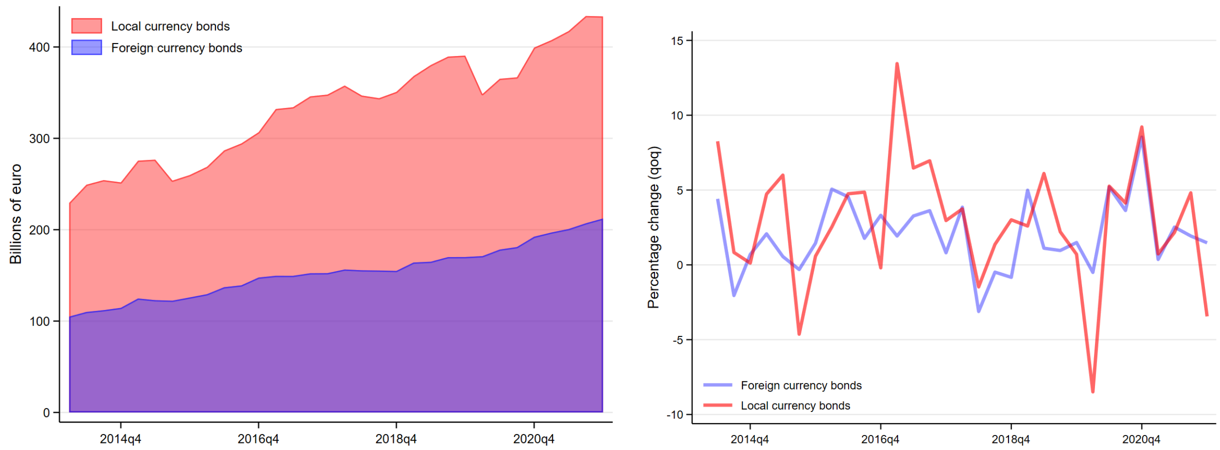
For our study, we exploit security-level detail on the issuer, the holder and the currency of each bond to define the relevant exchange rates for currency mismatches on both the borrower and the lender sides. We focus on euro-area investors that are a substantial part of the investor pool for EME sovereign debt. Figure 1 shows the corresponding slice of the ECB's Securities Holdings Statistics (SHS-S). At end-2021, euro area investors held €433 billion in EME sovereign bonds, €221 in local currency and €212 billion in foreign currency bonds, 65% of which are denominated in US dollars (left panel).[1] The euro area accounts for 20% of foreign currency and 5% of local currency bonds outstanding, respectively.

The dramatic retreat of global investors at the onset of the pandemic illustrates a mechanism that we also detect in normal times. The events unfolding in March 2020 took a toll on EME sovereign bond holdings of euro area investors, almost exclusively on their local currency bond portfolios (red area). Much of the observed drop reflects a valuation effect, since EME currencies depreciated sharply over that quarter. To isolate net selling, we construct series in nominal values at constant exchange rates which exclude any valuation effects. The holdings of local currency bonds are far more volatile than those in foreign currencies (right panel). Euro area investors sold 8.5% of their aggregate EME local currency bonds in Q1 2020, compared to 0.5% of foreign currency bonds of

[1] Throughout the paper, we use "foreign currency" from the perspective of the borrower country. For Mexico, for instance, this includes sovereign bonds denominated in dollars, euros, pounds and yen.

the same sovereigns.

Figure 1. **Local versus foreign EME debt holdings by EA investors**



(a) Total nominal amount (b) Changes nominal amount (constant FX)

Panel (a) shows the total nominal amount of EME debt held by euro area investors (in billion EUR). Panel (b) shows the percentage change in nominal amounts while keeping the exchange rate (FX) constant over time. Both panels show the results separately for local and foreign currency debt. The quarterly sample period is 2013q4-2021q4.

What accounts for so stark a difference? This particular episode saw EMEs depreciate against the euro, and the US dollar appreciated against all currencies – scaling record highs as the world's safe haven. With so much variation across many currency pairs, our dataset affords an ideal laboratory for studying the financial channel of exchange rates. For identification, our focus on euro-based investors decouples the lender's reference currency (euro) from the borrower's currency for invoicing and external debt (mostly dollar), and that of global financial conditions more generally (dollar).

Our empirical findings highlight systematic and distinct responses of euro-based investors to three types of exchange rates. An increase in the broad dollar index (BDI) leads to net selling across the board, consistent with a stronger dollar reflecting tighter global financial conditions. A rise in the broad euro index (BEI), on the other hand, triggers selling of local currency bonds, in line with the valuation losses a stronger euro implies for assets in other currencies in terms of the reference currency. In addition, investors sell more local currency bonds of individual EMEs that depreciate against the euro, precisely those bonds on which their currency mismatch hurts. These results are robust to variations in our specification and samples, and are not limited to EMEs: we find similar results for bonds issued by advanced economies outside the euro area.[2]

The locus of currency risk we observe is very specific, tied to lenders' balance sheets. When an

[2] Since our specifications are linear, we observe the opposite responses – investors buying sovereign bonds – when the dollar or the euro weaken, or when EME currencies appreciate.

EME depreciates, the rise in its debt burden may increase credit risk on foreign currency bonds; the same depreciation makes no difference for servicing local currency debt. Yet we find that investors primarily sell local currency bonds in response to a depreciation of an EME against the euro. Investors first react to the currency mismatch on their *own* balance sheet: the relevant exchange rate to global investors is the currency of the bond they hold, not the currency of the issuer country.

To further corroborate the channel of a currency mismatch on the lender side, we exploit the variation in currency exposures across euro area investors from differences in portfolio allocations to specific EMEs. For instance, some euro area countries hold larger exposures to Eastern European EMEs, whereas others primarily invest in Latin America. These different allocations allow to calculate portfolio-weighted currency exposures specific to investors in each euro area country. Using the methodology of Amiti and Weinstein (2018), we decompose changes in holdings to extract the lender-specific components, and show that the lender-specific currency exposures have more explanatory power for the net selling of local currency bonds than a broad depreciation of EMEs against the euro. Finally, we rationalize our empirical findings by expanding a standard portfolio choice problem to incorporate the currency dimensions relevant for global investors holding local and foreign sovereign bonds.

Our findings shed new light on the financial channel of exchange rates and its empirical relevance. Much of the literature concerns the vulnerability of foreign-currency borrowers (e.g. Du and Schreger 2022; Eichengreen et al. 2005). The other side, the exposure of local-currency lenders, has received less attention. Putting both sides together makes clear how currency risk compounds the procyclicality of capital flows. We provide new evidence on the lender side: where currency mismatches expose lenders to depreciations, valuation losses trigger substantial portfolio outflows.

Currency denomination plays a key role in shaping portfolios, an insight that resonates with the findings of Boermans and Vermeulen (2016); Burger et al. (2018); Maggiori et al. (2020); Burger and Boermans (2022). In particular, our results are complementary to those of Maggiori et al. (2020) on the extreme currency preferences of corporate bond holders. They show that corporates generally cannot borrow abroad in their own currency, but have to issue bonds denominated in US dollars or in the currency of foreign investors. We focus on sovereigns who *can* borrow abroad in their own currency, but doing so comes with the drawback that foreign investors holding those local currency bonds are highly sensitive to depreciations in the sovereign's currency.

The behaviour we observe has important implications for EMEs and small open economies. Investors exposed to currency risk may sell at the first sign of depreciation regardless of the underlying credit risk. For lenders to continue holding local currency bonds, borrowers pay a sizeable yield spread over US Treasuries, mainly to compensate for currency risk (Du and Schreger 2016; Lee 2022).[3] As a result, most countries borrowing abroad in their own currency face risks that mirror those of foreign currency debt. Since the 1990s, major EME sovereigns have made sub-

[3]For EMEs, the currency risk accounts for about three quarters of the local currency yield spread over US Treasuries, while the borrower's intrinsic credit risk accounts for one quarter (Du and Schreger 2016).

stantial progress in borrowing abroad in their local currency; they are overcoming "original sin" (Eichengreen et al. 2005) in the original sense of the term. But the flipside of this trend is that currency mismatches migrate to the balance sheets of global investors, leading to volatile capital flows in periods of stress (Hofmann et al. 2022). The problem changes shape, but countries remain vulnerable to depreciations and global financial conditions – even when they owe no foreign currency debt.

The paper is structured as follows. Section II reviews the main channels through which exchange rates affect lenders and borrowers, and explains how we disentangle the effects by focusing on euro-based investors. Section III describes how we combine two granular databases to enable our empirical approach. Section IV presents the baseline regressions at three levels of aggregation, along with robustness tests and a further exploration of the currency mismatch on the lender side. Section V lays out a model to rationalize our empirical findings. Section VI concludes.

II. Literature and Channels

This section reviews the main channels through which exchange rates affect lenders and borrowers in view of testable hypotheses. In particular, we examine the role of currency mismatches on local and foreign currency debt, respectively, as featured in the literature on the financial channel of exchange rates. We then explain how we identify these effects separately for borrowers and lenders by focusing our empirical analysis on the EME sovereign bonds held by euro-based investors.

A. Exchange Rate Channels in the Literature

We briefly classify various exchange rate effects with a view to inferring the expected behavior of international lenders in response to those exchange rates. For concreteness, consider a generic open economy (country c) that trades goods invoiced in US dollars with many countries, and borrows abroad in dollars, unhedged. Foreign investors lend or invest on the basis of prospective returns across a number of borrower countries, including c. Exchange rate movements that have contractionary (or expansionary) effects on country c can be expected to lead to net selling (or buying) of exposures by foreign investors.

Several types of exchange rates or indices can be relevant in this context. The bilateral exchange rate (BER) is the nominal exchange rate against the reference currency, quoted in terms of local currency units per US dollar ($BER_c^{\$}$) or per euro ($BER_c^{€}$). An increase represents a depreciation of country c's currency. The broad dollar index (BDI) is a weighted average of the foreign exchange value of the US dollar against the currencies of a broad group of major US trading partners; an increase denotes dollar strength. The broad euro index (BEI) is the corresponding nominal index measuring the value of the euro against the euro area's main trading partners.

We begin with the traditional **trade channel** of exchange rates. In the presence of nominal rigidities, exchange rate fluctuations affect relative prices and real variables. By virtue of trade competitiveness, depreciations are expansionary (Dornbusch 1980; Obstfeld and Rogoff 1995). Country c's net exports increase as the depreciation of its currency raises the price of imports relative to that of exports. From the foreign investor's perspective, this form of export-led growth makes country c more attractive, leading to more investment when its currency depreciates ($BER_c \uparrow$).[4]

The vast majority of trade is invoiced in major currencies, notably the US dollar (Boz et al. 2020). "Dominant currency pricing" ties the real effects to the dollar rather than to other exchange rates: a depreciation against the US dollar in particular is expansionary, since it reduces country c's imports from all other countries. However, many countries depreciating simultaneously – i.e. a broad-based strengthening of the US dollar – tends to depress world trade (Gopinath et al. 2020). Therefore, one would expect more investment when country c depreciates against the dollar ($BER_c^{\$} \uparrow$), but less investment across the board in response to generalised dollar strength ($BDI \uparrow$).

The **financial channel** of exchange rates has gained prominence after manifesting itself in numerous financial crises over the past decades. The form it takes depends on currency denomination. The traditional focus is on the ***borrower side***, since most countries' external debt is denominated in foreign currency (Bénétrix et al. 2019; Eichengreen et al. 2022). Depreciations raise the burden of foreign currency debt in terms of the borrower's own currency, with adverse effects on the economy and the financial system. Other than in Europe, most countries around the world borrow internationally in US dollars; the relevant exchange rate for country c is its domestic currency against the dollar. Since a depreciation ($BER_c^{\$} \uparrow$) is contractionary and raises the borrower's credit risk, foreign investors are likely to react by cutting exposures.

In this context, dollar strength can produce broader effects. If the US dollar strengthens against many countries simultaneously, global investors face higher credit risk across their entire portfolio, and tighter financial constraints can reduce exposures across portfolios, with aggregate effects (Bruno and Shin 2015). A generalised strengthening of the dollar ($BDI \uparrow$) may thus lead to a broad-based reduction in credit. Taken together, we expect cuts in foreign investments to any country whose currency depreciated against the dollar ($BER_c^{\$} \uparrow$), and a broader reduction in investment if the BDI rises as well.

Currency mismatches also occur on the ***lender side***. Most advanced economies and major EMEs increasingly borrow abroad in their own currency (Bénétrix et al. 2019; Du and Schreger 2022; Onen et al. 2023). A depreciation can be inconsequential for borrowers servicing their local currency debt. But the currency mismatch now sits on the balance sheets of foreign lenders holding such debt: since they measure returns in dollars or in their own currency, the depreciation of currency c causes valuation losses. When foreign investors hold local currency debt, their portfolios are therefore more exposed to *currency risk* than to the *credit risk* associated with the borrower's foreign-currency debt.

More generally, lenders will face tighter financial constraints when their reference currency appre-

[4] The extent to which country c's currency depreciates against several of its trade partners is captured by the country's nominal effective exchange rate ($NEER_c$).

ciates. Such an appreciation represents the simultaneous depreciations of many other currencies in their portfolios, implying lower valuations in terms of the reference currency. This can tighten lenders' VaR constraints and reduce the intermediary capacity in the financial system (Hofmann et al. 2022). Since the dollar serves as reference currency to global investors, empirical work has found that the BDI gauges global risk-taking capacity and EME financial conditions (Avdjiev et al. 2019; Hofmann et al. 2022). From the lender side, we thus expect foreign holders to reduce their investments across the board in the event of a broad-based depreciation across many borrower countries ($BDI \uparrow$), and to cut their local currency positions on individual countries facing larger depreciations ($BER_c^{\$} \uparrow$).

B. Identification through Euro-based Sovereign Bond Investors

Our brief review makes clear that exchange rates operate through multiple channels affecting the ways investors extend credit to borrower countries. Due to its dominance in global finance and trade invoicing, the US dollar in particular plays several roles, which makes it hard to disentangle the various channels empirically. We now define the data dimensions best suited for capturing the financial channel of exchange rates, with the aim of identifying separate currency mismatch effects for borrowers and lenders.

First, we focus on **major EMEs** as borrower countries. Major EMEs stand out for attracting external finance in both foreign and in local currencies.[5] Investors can often choose between local currency and foreign currency debt of the same issuer. At the same time, investors typically enter EMEs on an unhedged (or partially hedged) basis, since EME currencies are costly to hedge.[6] As an illustration, Figure 3 uses regulatory data to show that Dutch pension funds hedge at most a small fraction of their local currency sovereign bonds: their overall derivatives position in the respective currencies is much smaller.[7] Focusing on EME borrowers also limits the risk of endogeneity, since EME investments remain relatively small in global portfolios (Broner et al. 2022).

Second, we examine a particular asset class: **sovereign bonds**. This helps to reduce the confounding effects of the trade channel on the financial channel of exchange rates. Corporates are subject to both channels: a depreciation of currency c has expansionary effects (trade channel) as well as adverse balance sheet effects, especially with respect to the dollar – the currency of choice for most corporates issuing international bonds (e.g., Salomao and Varela 2022; Gutierrez et al. 2023).[8] Focusing on sovereign bonds minimizes trade-related effects, and leads to a clear prediction: a depreciation has a negative effect on foreign currency borrowers, but has no direct effect on local

[5] By contrast, advanced economies tend to borrow in their own currency, while small EMEs and developing countries rely almost exclusively on foreign currency when borrowing abroad (Eichengreen et al. 2022).

[6] The extent of hedging among foreign investors in EME local currency debt is known to be low in general (Siddiqui et al. 2020). Full hedging seem to be the exception, given that the cost of hedging eliminates much of the yield spread on EM sovereign bonds. The arguments in the paper remain intact under partial hedging.

[7] This finding is specific to EMEs: pension funds hedge major currencies and in particular the USD (Du and Huber 2023).

[8] EME corporates issue predominantly in foreign currency, whereas EME governments issue both in local and foreign currency (Du and Schreger 2022).

currency borrowers.

We study **bond holdings** instead of debt liabilities more generally. Sovereign bonds have become the main instrument for government borrowing (in contrast to the 1980s); they serve as financial market benchmarks, and they can be sold and repatriated in stress episodes. Sovereign bonds are widely traded, held and reported, which allows us to track net selling and buying of bonds in official statistics (see Section III). Moreover, bonds come with a clear currency denomination, whereas for loans the split into local vs foreign currency is often unavailable.

Most importantly, we focus on **euro-based investors**. Rotating the reference currency away from the US dollar allows for better identification of lender-specific effects. Every channel covered above involves dollar-based exchange rates, since the greenback is the dominant currency in global finance – from trade invoicing and FX trading to the composition of external debt and official reserves. The euro is less central in the channels above, yet boasts a substantial investor base - the euro area. By focusing on euro-based investors, we can identify the various channels more precisely than would be possible with global or dollar-based investors. Doing so decouples the investor's reference currency (euro) from the borrower's relevant currency for invoicing and external debt (mostly dollar), and that of global financial conditions more generally (dollar).

Figure 2 sets out the expected effects of EME depreciations on foreign bond holdings according to the financial channel of exchange rates. The effects highlighted in the literature are associated with exchange rates referencing the dollar. Most EME borrowers face rising debt burdens when their currency depreciates against the dollar; and global financial conditions tighten during episodes of dollar strength ($BDI \uparrow$), leading to investor retrenchment for the reasons stated.

Exchange rates referencing the euro are less consequential for EME borrowers. Few EMEs have substantial issuance in euro; since these are a minority, foreign investors are unlikely to systematically shed bonds whenever EMEs depreciate against the euro, nor do such depreciations materially raise credit risk across lenders' FX bond portfolios. We thus expect weak or no reactions to $BER_c^{€}$ and BEI in their foreign currency bond holdings (light grey cells in Figure 2).

However, exchange rates referencing the euro are highly relevant to euro-based lenders. While global and dollar-based investors will respond to $BER_c^{\$}$, as described above, euro-based investors should react to $BER_c^{€}$ and the BEI instead. Euro-based investors face losses on local currency bonds for any EME that depreciates against the euro ($BER_c^{€} \uparrow$). Moreover, a broad-based euro appreciation ($BEI \uparrow$) is likely to lead to more extensive selling across EMEs than the equivalent depreciation of a single EME ($BER_c^{€} \uparrow$), due to financial constraints facing euro-based investors: the mechanism analysed in (Hofmann et al. 2022) now applies with respect to the euro. This does not preclude that increases in the BDI also elicit responses from euro area investors, since a stronger dollar exacerbates global financial conditions and the currency mismatches of dollar-dependent borrowers.

Figure 2. Financial channel of exchange rates

Reference currency	Type of exchange rate	EMEs borrowing in: Foreign currency	EMEs borrowing in: Local currency
USD	**Bilateral: $\mathbf{BER_i^{\$}}$**	**(-) Dollar borrowers** ***FC debt burden***	**(-) Global lenders** ***Currency mismatch***
	Index: BDI	**(-) Global lenders** ***Risk capacity***	
EUR	**Bilateral: $\mathbf{BER_i^{€}}$**	(-) Euro borrowers *FC debt burden*	**(-) Euro-based lenders** ***Currency mismatch***
	Index: BEI	(0) *Few EMEs owe euro*	**(-) Euro-based lenders** ***Risk capacity***

The figure summarises the expected effects of EME depreciations on foreign holdings of EME sovereign bonds. The columns split EME bonds into foreign versus local currency (the domestic currency of the EME borrower). The rows show the various exchange rates, grouped by reference currency. Each cell indicates whether a given type of exchange rate effect arises on the borrower or on the lender side, and states the expected sign (or 0 if no effect). All exchange rates are quoted as local currency per dollar (or euro), so that an increase represents a depreciation of EME currencies and a stronger dollar (euro). BDI=Broad dollar index; BEI=Broad euro index. BER=bilateral exchange rate against dollar (euro).

III. Data and Methodology

A. *Granular Statistics on Bond Holdings*

We use the euro area Securities Holdings Statistics by Sector (SHS-S) that record securities holdings for each country and sector in the euro area over the period 2013q4-2021q4.[9] For each country and sector, the statistics contain information on the quarter-end holdings at the ISIN level; for instance, the SHS-S data reports the aggregate holdings of German insurance companies in a specific security.

The SHS-S are connected to the Centralised Securities Database (CSDB). The aim of the CSDB is to hold accurate information on all individual securities relevant for the statistical purposes of the European System of Central Banks (ECB 2010). For a large number of debt securities, the CSDB contains data on debt type, maturity dates, coupon rates, coupon frequencies, coupon type (e.g., fixed, floating or zero-coupon), last coupon payment date, yield-to-maturity, prices, and amount outstandings.

We also merge the SHS-S data with data on exchange rates and macroeconomic series. The bilateral nominal exchange rates against the US dollar and the euro (BER) are from the BIS (end of period). The BDI is the broad nominal US dollar index against 26 major trading partners from the Federal

[9] For more details on the SHS-S data, see for instance `https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012R1011`, Koijen et al. (2017), and Koijen et al. (2021).

Reserve, and the volatility index (VIX) is from the Chicago Board Options Exchange (both retrieved from FRED). The BEI is the nominal effective euro exchange rate against 41 main trading partners from the ECB. Credit ratings are from Fitch Ratings. We also merge the data with sovereign bond yields from JP Morgan indices.[10] The yield differentials are computed with respect to the US Treasury yield (dollar) and the German Bund yield (euro). Macroeconomic series such as GDP growth, fiscal capacity, and inflation for each country are from the IMF WEO.

For debt securities, the focus of this paper, the SHS-S reports bond holdings in both nominal and market values expressed in euros. To isolate active changes in allocations from fluctuations in prices and exchange rates, we focus on nominal debt holdings and convert nominal values to their original currencies using exchange rates against the euro. We then convert the nominal values back to euros at constant exchange rates as of 2021q4.

For the reasons elaborated above, we focus on EME sovereign bonds held by euro-based investors. Our empirical approach takes advantage of the bilateral nature of the bond holdings statistics. On the lender side, the data comprises bond holdings in the 19 euro area countries.[11] On the borrower side, we focus on 27 major emerging markets that make up most of the investible EM bond universe.[12]

B. *Empirical Methodology*

Our analysis proceeds from general to specific. We first combine all euro area investors, and present regressions at three levels of aggregation on the borrower side: all EMEs combined at the aggregate level (time series), at the EME country level (panel), and at the individual security level (large panel). Further analysis then makes use of heterogeneity on the lender side, exploiting the different portfolio exposures that individual euro area countries hold across the EMEs in the sample.

The dependent variable is the change in log nominal values (as in, e.g., Timmer 2018), corrected for exchange rate fluctuations. As described, by applying a fixed exchange rate (2021q4) over the sample period, the changes in log nominal values contain active changes by euro area investors and exclude price and currency valuation effects. The main regressors of interest are the different exchange rates outlined in Section A. Formally, we run the following regressions:

1. **Aggregate level** (time series):

$$\Delta \ln N_{FD,t} = \alpha + \beta_1 \Delta BDI_t + \beta_2 \Delta BEI_t + \beta_3 \Delta C_{FD,t} + \epsilon_{FD,t}, \quad (1)$$

[10] We use individual country series from the GBI-EM Broad Diversified Index for local currency bonds; the EMBI Global Diversified Index for dollar-denominated external government bonds, and the Euro EMBIG Diversified Index for euro-denominated external government bonds.

[11] Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, Spain. This list excludes Croatia, which entered the euro area in January 2023.

[12] Argentina, Brazil, Bulgaria, Chile, China, Colombia, Croatia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Singapore South Africa, Taiwan (Chinese Taipei), Thailand, and Turkey.

where ΔBDI_t equals the change in the log BDI from time $t-1$ to t; ΔBEI_t the change in the log BEI from time $t-1$ to t; and $C_{FD,t}$ the controls for foreign/local debt at time t.

2. **Country level** (panel):

$$\begin{aligned}\Delta \ln N_{c,d,t} &= \alpha + \beta_1 \Delta BDI_t + \beta_2 \Delta BEI_t + \beta_3 \Delta BER^{€}_{c,d,t} \\ &+ \beta_4 C_{c,d,t} + \gamma_{c,d} + \epsilon_{c,d,t}, \end{aligned} \tag{2}$$

where $\Delta BER^{€}_{c,d,t}$ equals the change in the log bilateral exchange rate for country c and currency of denomination d with respect to the euro from time $t-1$ to t, $C_{c,d,t}$ the controls for country c and currency of denomination d at time t, and $\gamma_{c,d}$ are fixed effects at the country-currency level. We orthogonalize $\Delta BER^{€}_{c,d,t}$ with respect to the BEI when combined in the regression with the BEI.

3. **Security level** (large panel):

$$\begin{aligned}\Delta \ln N_{s,t} &= \alpha + \beta_1 \Delta BDI_t + \beta_2 \Delta BEI_t + \beta_3 \Delta BER^{€}_{s,t} \\ &+ \beta_4 C_{s,t} + \gamma_s + \epsilon_{s,t}, \end{aligned} \tag{3}$$

where $\Delta BER^{€}_{s,t}$ equals the change in the log bilateral exchange rate for the currency of denomination of security s with respect to the euro from time $t-1$ to t, $C_{s,t}$ are controls for security s at time t, and γ_s are security fixed effects.

In our regressions, we control for several factors distinct from currency effects (C). First, we control for the change in log total amount outstandings (TAO) of EME debt in all three specifications. The reason is to take into account that the growth in the TAO in sovereign bonds of a specific EME will lead to more investors moving towards that EME, notably due to benchmarking. We also control for changes in the VIX to capture uncertainty in the economic outlook. Likewise, at the country and security level, to control for changes in country-specific macro fundamentals we include changes in yield differentials, credit ratings, GDP, fiscal capacity, and inflation.[13] Finally, at the security level regressions, we also control for the remaining time to maturity of the bond to capture that investors typically target a specific duration of their portfolios; investors will buy bonds with longer time to maturities over time.

C. Summary Statistics

In the introduction, we showed that the holdings of EME debt are more volatile over time than the foreign holdings. Figure 4 shows that euro area investors hold a larger share of the foreign (20%) than local currency debt (5%) outstanding, consistent with the finding in Maggiori et al. (2020) that foreign investors mainly hold debt in their own currency or in USD. The latter finding

[13] We allow for differences in the yield differentials and credit ratings for debt denominated in local versus foreign currencies.

reduces concerns of endogeneity issues that euro area investors trades in local currency debt directly impacts exchange rates.

Table 1 and 2 summarize our main variables of interest. An important point to note is that the low correlations across the different types of exchange rates helps support our identification of the different financial channels. First, dollar strength and euro strength are quite distinct: the correlation between ΔBDI and ΔBEI at the quarterly frequency equals -0.36. Since the euro area and the US are major trade partners to each other, the EUR-USD exchange rate tends to push the BDI and BEI in opposite directions; moreover, each currency area has a different set of other major trade partners. Note also that depreciations of specific EME currencies are different from the general movement in the BDI: the correlation between changes in $BER^{€}$ and BDI is 0.00. Therefore, an EME depreciation against the euro (which affects euro-based lenders holding local currency bonds) can occur independently of the broad effects associated with a strong dollar.[14]

[Place Table 1-2 about here]

IV. Baseline Results at three Levels of Aggregation

This section presents our baseline results, regressing the euro area investors' holdings of EME sovereign bonds on exchange rates and controls. As described, we run analogous regressions at each level of granularity: for all EMEs combined (Table 3), at the country level (Table 4) and at the security level (Table 5). Each table distinguishes local from foreign currency bonds in order to test the expressions of the financial channel of exchange rates set out in Figure 2, focusing on the significance of the different exchange rates referencing the dollar and the euro, respectively. The section ends with extensions and robustness tests.

A. Aggregate Analysis

Treating all EMEs as an aggregate reduces the analysis to a simple time-series regression (Table 3). The only controls are the log changes in the VIX and in total sovereign debt outstanding for all EMEs combined. Even at this coarse level the importance of exchange rates for foreign holdings of sovereign bonds is evident.

The coefficient on the BDI is negative and significant throughout. Taking the point estimate at face value, when the dollar strengthens by 1%, investors sell about 0.8% of their EME bond holdings (Column "All").[15] For local currency bonds, the response is more than one for one, whereas foreign currency bonds appear less sensitive to the dollar index.

A strengthening of the euro ($\Delta BEI > 0$) is also associated with net selling of EME sovereign

[14] The correlation between changes in $BER^{€}$ and $BER^{\$}$ is also low, indicating that an EME depreciation against the euro can occur without raising the dollar debt burden of the sovereign at the same time.

[15] As described in the data section, the log change in holdings represents active allocation decisions, since the series excludes currency and other valuation effects by construction.

bonds. The effect is similar, if weaker, to that of the dollar index. However, the key difference is that the effect only appears for bonds denominated in EMEs' local currencies (Column "Local"). This is a first sign that euro-based investors face a currency mismatch on local, not on foreign, currency bonds (Figure 2). To explore this channel, we need more variation in exchange rates by going to the country-level regressions.

[Place Table 3 about here]

B. Country-level Analysis

The country-level regressions treat each EME separately, and thus provide more heterogeneity across currency pairs (Table 4). We examine how investors adjust their bond holdings vis-à-vis every EME, depending how that EME's currency moves against the euro over each quarter ($BER_c^{€}$). The bilateral rates now capture currency risk for euro-based investors holding local currency bonds.

Dollar strength tends to reduce bond holdings, as is apparent from all specifications of Table 4. A broad appreciation of the euro has a similar effect, but confined to local currency bonds ("Local" columns). For both indices, the effect is strong: when the dollar or the euro strengthten by 1% , investors reduce their holdings of EME bonds by 1% on average. The size of this euro-index effect drops to about a third when replacing the BEI by the bilateral rate between the euro and each EME currency ($BER_c^{€}$), in the middle columns of Table 4.

The right columns include both indices along with the bilateral exchange rates with respect to the euro. The coefficients on both indices are consistent with earlier results, after orthogonalising $BER_c^{€}$ with the respective index to avoid multicollinearity. That means $\Delta BER^{€,ort}$ measures by how much *more* an EME depreciates against the euro than what the broader euro appreciation implies. The columns reveal that at the country level, the broad euro index explains changes in holdings of local currency debt and not individual EME depreciations against the euro.

[Place Table 4 about here]

C. Security-level Analysis

In the security-level regressions we can make use of the rich dimensionality of the matched SHS-S-CSDB dataset (Section III). It allows us to control for security fixed effects, so that we are sure our findings are not driven by security characteristics such as maturity, coupons or issue size. The granular security level data also alleviates concerns over endogeneity, since individual bonds sold in response to depreciation will not materially deepen that EME's depreciation (see Camanho et al. (2022)). The sample size jumps from 1,751 (country-level) to almost 44,000 observations in Table 5.

The results in Table 5 confirm our earlier findings with greater precision. Dollar strength leads to net selling of all types of EME sovereign bonds, with a greater effect on local than on foreign currency bonds. The elasticities are smaller in magnitude than for the country-level regression, but highly significant in most specifications. Global financial conditions, as gauged by the BDI, seem to play a considerable role – even for euro area investors.

When EMEs depreciate against the euro, euro-based investors tend to shed bonds of the respective sovereign. The reaction to $BER_c^{€}$ is systematic for local currency bonds where investors face the currency mismatch; it is insignificant for foreign currency bonds, where borrowers face the mismatch. Euro-based investors also sell local currency bonds when the euro appreciates more broadly (against euro area trade partners). Their holdings of foreign-currency bonds do not react in measurable ways. Note that the effects of broad euro appreciation (BEI) are consistently larger than those of a bilateral euro appreciation against individual countries ($BER_c^{€}$). This matches the findings of (Hofmann et al. 2022) and is indicative of the role played by financial constraints.

[Place Table 5 about here]

The fact that foreign currency bonds are retained while local currency bonds are sold in response to depreciations is indicative of a lender-specific effect. Euro-based investors face valuation losses only on local currency bonds, not on the foreign currency bonds they hold. If investors viewed local currency bonds as risky on account of the sovereign's dollar borrowing, they would sell both types. But they might be unconcerned about a depreciation against the euro since most EMEs borrow predominantly in dollars, not euros.

Of these results, the strength and consistency of the BDI across all specifications was unexpected. For foreign currency bonds, it stands to reason that dollar strength would raise the borrower's debt burden, which also fuels credit risk to euro-based investors holding dollar bonds (recall Figure 2). More of a surprise is the consistent negative response to the BDI for their *local currency* holdings - after all, dollar strength does not imply EME depreciation against the euro.[16] The theory in (Hofmann et al. 2022) predicts that response for the BEI (instead of the BDI) when applied to euro-based investors. A plausible explanation is that changes in global financial conditions (as measured by the BDI) also affect euro-based investors, via funding availability and risk appetite.

D. Extensions and Robustness

The results at all levels of aggregation so far suggest that global investors systematically react to different types of exchange rates. A stronger dollar (BDI) has the broadest effect on bond holdings, akin to a global risk factor; a stronger euro (BEI) affects local currency bonds in general, consistent with its role in euro-based investors' financial constraints; and bilateral depreciations against the euro trigger net selling of specific local currency bonds on which euro-based investors face a currency mismatch - identified without confounding dollar-related effects. These findings are consistent with the channels illustrated in Figure 2. The remainder of this section examines whether these findings remain robust in specifications designed to address various caveats.

[16] The BDI and BEI are negatively correlated, in part because the EUR-USD exchange rate has a large weight in both indices but moves them in opposite directions.

Advanced economies. The analysis so far focused on a particular slice of the securities holdings statistics for reasons of identification, namely euro-based investors' holdings of sovereign bonds issued by major EMEs. The same mechanism could be at play for bonds issued by advanced economies (AEs), although exposures to AE currencies are more likely to be hedged. Table 6 runs the security-level regressions for sovereign bonds issued by major AEs outside of the euro area; we also exclude the United States to avoid confounding effects from the US dollar. As major AE sovereigns issue mostly in their own currency, the table presents estimates for local currency bonds and omits the foreign currency column.

The results again show that euro area investors sell local currency bonds when the BEI rises, consistent with the notion of tightening financial constraints when assets in other currencies lose value in terms of euro. In addition, the $BER_c^{€}$ has a negative impact on holdings, indicating that investors sell more of those AEs that depreciate against the euro. The estimated magnitude is larger than for EMEs, perhaps because AE bonds account for a larger share of investor portfolios, implying a greater effect on financial constraints.

EMEs borrowing euro. One concern is that the separation between borrower FX risk (mostly dollar) and investor currency mismatch (with respect to the euro) is not as clear-cut as we think. Several major EMEs in Europe rely to a large extent on euro-denominated borrowing, notably Bulgaria, Croatia, Czech Republic, Hungary, Poland, and Romania.[17] In those cases, depreciations against the euro play a dual role: causing losses on investors' local currency bond holdings *and* raising borrowers' debt burdens. Table 7 shows that excluding this set of borrowers from the baseline regression leaves results qualitatively unchanged. Hence, there is little evidence that euro borrowing among some EMEs undermines our identification of the channels in Figure 2.

Currency of bond vs issuer. Another possible concern is that country risk may blur the line between the reactions to local and foreign currency bonds of the same sovereign. It is possible that the burden that, say, Chile faces on its external dollar debt also makes its Chilean peso bonds more risky – defaults need not be selective. The specifications so far treated local and foreign currency bonds as distinct investments; holdings were assumed to react to the currency denomination of the bond, i.e. to dollar-euro rate for dollar bonds, and to the Chilean peso-euro rate for Chile's local currency bonds. However, if depreciations hurt a sovereign's creditworthiness overall, perhaps *all* bond holdings (also foreign currency bonds) respond to a depreciation of that issuer's currency.

To test this idea, we align the bilateral euro rate with the issuer country: in the example above, holders of Chilean bonds now face the peso-euro exchange rate, even on Chilean bonds issued in dollars or euros. Table 8 leaves several earlier results unchanged: including net selling in response to dollar strength, and the shedding of local currency bonds when the euro appreciates and when specific EME currencies depreciate. However, a novel result is that euro-based investors seem to

[17] Each of these sovereigns has half or more of the government bonds issued as international debt securities (IDS) government bonds denominated in euros. More generally, the euro also accounts for a large share of their overall external debt liabilities at the country level (Bénétrix et al. 2019).

buy foreign-currency bonds in those circumstances, as evidenced by the *positive* signs on ΔBEI and $BER_c^{€}$. Seeing opposite signs suggests that investors shift from local to foreign currency bonds of the same sovereign when its currency depreciates. The same occurs when the euro appreciates (BEI) causing losses on other non-euro assets; though that effect is driven by euro-denominated bonds and disappears when they are excluded.

The net buying of foreign currency bonds is not as robust as the net selling of local currency bonds in response to EME depreciations. Even so, it is interesting to see holdings of local and foreign currency bonds move in opposite directions only because they have different currency denominations. These findings underscore that the relevant currency for investors is that of the bond they hold and the currency mismatch they face on their own balance sheet.

Investment funds and custodians. Belgium, Luxembourg, and Ireland are well-known for their funds industry and custodians that invest or hold financial assets on behalf of investors in other jurisdictions (Tabova and Warnock 2022). If the ultimate investors reside outside the euro area, the relevant currency mismatch may not relate to the euro. Indeed, Beck et al. (2023) show that the UK investors often invest through investment funds in Luxembourg and Ireland. Table 9 shows that excluding these financial centers does not alter our findings. In fact, the reaction to euro-based exchange rates strengthen – an intuitive result, given that the modified investor base contains fewer non-euro area investors.

Analysis by sector. Finally, the channels we have in mind may not be relevant for all types of lenders. Some institutions mark to market continuously, others realise valuation losses only when bonds are sold or repaid. Lenders may face leverage constraints, or VaR constraints, or investment mandates leading to very different portfolios. To account for such differences, we run the baseline regressions separately for each investor type: banks, insurance companies, pension funds, mutual funds, and the rest.

We find that most of the effects are driven by mutual funds (results available from the authors). Their procyclical response to exchange rates is in line with industry evidence that funds react to mark-to-market losses and redemptions. These results are similar to those in Bertaut et al. (2021), with the benefit of our more granular dataset: they show that mutual funds are more sensitive to exchange rates than other investors in local currency bonds. Shek et al. (2018) also document substantial bond sales by EME bond mutual funds during the taper tantrum of 2013, with sales exceeding investor redemptions.

These results highlight the potential of exploiting the heterogeneity across lenders for better identification, an approach we pursue in the final section.

[Place Table 6-9 about here]

E. Exploring the Lender Currency Mismatch Effect

So far, our findings suggest that the currency mismatch on the lender side plays an important role in shaping investors' holdings of local currency debt. To further corroborate this idea, we make use of heterogeneity on the lender side by exploiting the different portfolio allocations, and hence currency exposures, that investors in different euro area countries maintain. Whereas earlier results were for all euro area investors combined, here we investigate the exposure of each euro area country to individual EMEs. Formally, we look at changes in holdings $N^{l}_{c,d,t}$ on EME country c separately for euro area country l, by currency of denomination d. This level of granularity is motivated by different exposures that euro area investors have to EMEs.

As a preliminary step, Table 11 of the Appendix shows that the earlier country-level results (Table 4) remain similar when we break out each euro area country on the lender side. But there may be a common component that affects trading of all euro-area investors similarly. A more informative approach would make use of the currency mismatches specific to each euro-area country. We therefore propose a specification that relates lender-specific changes to lender-specific currency exposures. To do so, we decompose the changes in holdings into three components: common, borrower-specific (or EME specific), and lender-specific (or euro area specific) based on the methodology developed by Amiti and Weinstein (2018) (henceforth: AW).[18] The AW decomposition separates holdings' growth variation from each dimension in the data and a common component in such a way that the three components exactly decompose the aggregate growth in holdings. The common component reflects global growth in EME holdings, the median across all lender-borrower pairs and therefore does not speak to changes in holdings that are specific to lenders or borrowers. Likewise, shocks to specific EMEs may drive holdings of all euro area investors simultaneously. Extracting the lender-specific component therefore ensures that we are not picking up those two components that could bias the results in a second stage regression. We provide a technical description of the AW decomposition in our setting in Appendix A.

To apply AW, we focus on *local* currency debt, because there the mismatch on the lender side arises, and we group a few euro area countries that are small. In particular, we combine the holdings of the Baltic countries: Estonia, Latvia, and Lithuania. Likewise, we combine Italy and Malta as well as Greece and Cyprus. The result of the AW decomposition for euro area investors' holdings of local EME debt is summarised in Figure 5. It aggregates the three components across all euro area investors and EME countries. The important take-away from the decomposition is that lender-specific shocks play an important role in explaining overall growth in EME holdings.

[Place Figure 5 about here]

We then use the lender-specific component to link it to lender-specific currency exposures. We

[18] Other papers that apply their methodology include Amiti et al. (2019); Avdjiev et al. (2021).

compute the lender-specific currency exposures as follows:

$$CE_t^l = \sum_c w_{c,t-1}^l \Delta BER_{c,t}^{€}, \quad (4)$$

where $w_{c,t-1}^l = \frac{N_{c,t-1}^l}{\sum_c N_{c,t-1}^l}$, the exposure of euro area investor l to EME country c at time $t-1$. Figure 6 shows CE_t^l for all euro area investors over time. The currency exposures have a high correlation across investors in different euro area countries. However, there are also structural differences in the exposures over time, and in some periods the currency exposures even go in the opposite directions. This is not surprising. For instance, some euro area countries hold larger exposures to Eastern European EMEs (e.g. Poland and Romania), whereas others primarily invest in Latin America (e.g. Brazil and Mexico).

[Place Figure 6 about here]

Now that we have extracted a lender-specific component, we investigate how it links to the lender-specific currency exposure. Table 10 summarizes the results. We show the results using OLS and WLS, whereby we weight euro area investors on the relative fraction of their EME portfolio in local as opposed to foreign currency debt. The latter therefore gives more weight to those euro area countries that have larger exposures to local bonds within their EME portfolio. In all cases the currency exposures help explain the lender-specific component, with a negative sign. This implies that if euro area investors in country l experience a larger depreciation given the EMEs in their portfolio, they shed a larger share of their sovereign EME portfolio than other euro area investor with a lower exposure to EME depreciations. Conversely, when we link the lender-specific component to the broad euro index, we do not find that it has any explanatory power. This finding suggests that lender-specific currency exposures contain more information in explaining changes in investors' holdings.

[Place Table 10 about here]

V. A Mean-Variance Model of Sovereign Bond Portfolios

This section sets out a model to rationalize our empirical findings. We expand a standard portfolio choice problem to incorporate the currency dimensions relevant for global investors holding emerging market bonds. Bond investors chose between local currency and foreign currency bonds across different issuers, and value the returns in their own reference currency (e.g. euro) that differs from the dominant global currency (dollar). We first set out a generic portfolio choice problem, before specifying return processes amendable to a closed-form solution in the presence of covariance across bonds.[19] We then show that the comparative statics broadly match our empirical findings on the

[19] The set-up generalizes Aramonte et al. (2022) in several ways. Our predetermined capital constraint is simpler than in Hofmann et al. (2022), but we expand the investment choice to local and foreign currency bonds while allowing for reference currency other than the US dollar.

effect of different exchange rates on bond holdings.

A. Generic Portfolio Choice Problem

Consider a risk-neutral institution or investor who maximises expected returns subject to a Value-at-Risk (VaR) constraint of the form

$$\alpha\sigma_r \leq \kappa,$$

where σ_r denotes the standard deviation of the investor's return portfolio. The term α measures the stringency of the VaR constraint, and κ represents available capital.[20] Squaring the VaR gives rise to the traditional mean-variance approach of maximising expected portfolio returns subject to a constraint on the variance of the portfolio,

$$\sigma_r^2 = w'\Sigma w \leq \left(\frac{\kappa}{\alpha}\right)^2. \tag{5}$$

The investor chooses portfolio weights w at the beginning of t in view of expected returns μ. The terms α and κ will depend on other variables, but not on the current choice of w. From the Lagrangian:

$$\mathcal{L} = w'\mu - \lambda \left[w'\Sigma w - \left(\frac{\kappa}{\alpha}\right)^2 \right],$$

the first-order conditions satisfy:

$$\mu = \lambda \left(\Sigma + \Sigma'\right) w \quad \Rightarrow \quad w = \frac{1}{2\lambda}\Sigma^{-1}\mu. \tag{6}$$

The optimal choice equates the expected return from increased bond holdings with the marginal cost of additional risk. Using the binding VaR constraint (5) allows to solve for the Lagrange multiplier, $\lambda = \frac{\alpha}{2\kappa}\sqrt{\mu'\Sigma^{-1}\mu}$. Substituting λ into (6) yields the optimal portfolio,

$$w^* = \frac{\kappa/\alpha}{\sqrt{\mu'\Sigma^{-1}\mu}}\Sigma^{-1}\mu. \tag{7}$$

Optimal bond holdings are proportional to the effective capital available for managing portfolio risk, given the structure of expected returns and covariances.

Proposition 1. Optimal Bond Holdings

- The optimal allocation across individual bonds reflects their risk-adjusted expected returns $\Sigma^{-1}\mu$.
- The size of the overall bond portfolio is:
    - proportional to available capital κ.

[20] VaR is a percentile of the profit-and-loss experienced by an institution. The VaR at level α is a number x such that the probability that the loss exceeds x equals α.

– inversely proportional to the stringency of the VaR constraint α.

– inversely proportional to the generalised Sharpe ratio $\sqrt{\mu'\Sigma^{-1}\mu}$.

Before specifying returns and covariances, we discuss the role of capital and the VaR constraint. They are not exogenous, but predetermined. The investor solves a sequence of static portfolio choice problems each period: the portfolio w_t is chosen in period t, based on the expected returns from t to $t+1$, $E_t(r_{t+1}) = \mu_{t+1}$. The quantity of capital available is κ_t, reflecting the realised return of the previous portfolio,

$$\kappa_t = w'_{t-1}\, r_t.$$

Hence, available capital is higher if realized portfolio returns are higher, giving investors a larger cushion against future losses. The stringency of the capital constraint varies with global financial conditions over time. Since the BDI has attributes of a barometer of global risk-taking capacity, we allow the VaR constraint to tighten as the US dollar rises in value: $\alpha_t = v_t^{\pi}$, where v_t is a weighted average of the value of the US dollar against other currencies (BDI). Note that the multiplicative forms we use correspond to our empirical specification: given expected returns and covariances, the log-linearised percentage change in holdings, $\Delta\ln(w_t)$, is linear in the corresponding percentage changes in capital and exchange rates.

B. *Return Process and Covariances*

We now specify the structure of returns and covariances to which investors respond in their portfolio choice of equation (7). With n sovereign issuers, the model is of dimension $2n$ to encompass bonds denominated in local currency (LC) and in foreign currency (FC). For emerging market sovereign bonds, it would be unrealistic to posit independent and identically distributed returns. Our approach allows for linkages across bond returns, yet admits an explicit solution for $\Sigma^{-1}\mu$ in (7). We incorporate two forms of covariance on top of idiosyncratic risk: (1) A common price drift induces covariance across all bonds; and (2) LC bonds have a common component reflecting the currency risk associated with emerging market currencies. More formally, the returns for bonds issued by country i follow

$$\begin{aligned}\text{For LC bonds} &: \quad r^L_{i,t+1} = \chi^L_i + \delta_{t+1} + \gamma_{i,t+1}\\ \text{For FC bonds} &: \quad r^F_{i,t+1} = \chi^F_i + \varepsilon_{i,t+1}.\end{aligned}$$

The variables in the model relate to the exchange rates in our empirics as follows. Euro-based investors evaluate all returns in terms of their reference currency. FC bonds, if not denominated in euro, are hedged into euro to yield a return of $r^F_{i,t+1}$; the drift χ^F_i captures the risk premium of FC bonds (in country i). LC bonds are denominated in emerging market currencies and held unhedged; on top of the local-currency risk premium, χ^L_i, investors face currency risk. The common component δ_{t+1} captures a broad-based appreciation across currencies, and thus corresponds to (a decline in) the BEI; the idiosyncratic component $\gamma_{i,t+1}$ reflects a specific BER_i, i.e. the appreciation of a particular country's exchange rate against the euro. Euro-based investors may also respond to exchange rates referencing the dollar; in particular, v_t corresponds to the BDI which, through the financial constraint, affects the whole portfolio.

With this, the mapping from the model to the exchange rates in the empirics is as follows:

Empirics	Model
ΔBDI	$\Delta \log(v)$
ΔBEI	$-\delta$
ΔBER_i	$-\gamma_i$.

Following Proposition 1, the vector $\Sigma^{-1}\mu$ is the key ingredient for the comparative statics of how investors allocate their holdings across different bonds. To derive the expected returns and covariances needed for equation (7), we make the following assumptions. For FC bonds, $\varepsilon_{i,t+1}$ captures idiosyncratic variation in the general FC risk premium χ_i^F, with $\varepsilon_{i,t+1}^F \sim \mathcal{N}(0, f+\rho)$ i.d. (identically, not independently, distributed).[21] With this, the returns on foreign currency bonds are distributed as $r_{i,t+1}^F \sim \mathcal{N}(\chi_i^F, f+\rho)$. For LC bonds, the common component δ_{t+1} follows a random walk: $\delta_{t+1} = \delta_t + \eta_{t+1}$, with $\eta_{t+1} \sim \mathcal{N}(0, c)$ i.d.d. We also allow for persistence in the country-specific component $\gamma_{i,t+1} = \gamma_{i,t} + \nu_{i,t+1}$, with $\nu_{i,t+1} \sim \mathcal{N}(0, z+\rho)$ i.d. (identically, not independently, distributed). Combining the various components, LC returns follow $r_{i,t+1}^L \sim \mathcal{N}(\chi_i^L + \delta_t, z+c+\rho)$.[22] We assume that the covariance of the idiosyncratic components of returns across *all* bonds equals ρ. Hence, we have that $\text{Cov}(\nu_{i,t}, \nu_{j,t}) = \text{Cov}(\epsilon_{i,t}^F, \epsilon_{j,t}^F) = \text{Cov}(\nu_{i,t}, \epsilon_{j,t}^F) = \rho$.

Investors chose their portfolio based on expected returns; for bonds issued by country i, these are

$$\begin{aligned} \text{LC bonds:} \quad & E_t(r_{i,t+1}^L) = \mu_{i,t+1}^L = \chi_i^L + \delta_t + \gamma_{i,t} \\ \text{FC bonds:} \quad & E_t(r_{i,t+1}^F) = \mu_{i,t+1}^F = \chi_i^F. \end{aligned}$$

In every period, investors solve a problem of the same form. Dropping time subscripts to highlight the differential returns across countries and currency denominations, we can write expected returns

[21] We write it in this way for tractability to obtain an analytical solution. In particular, $\text{Cov}(r_{i,t}^F, r_{j,t}^F) = \rho$, hence $\text{Var}(r_{i,t}^F) = \text{Cov}(r_{i,t}^F, r_{i,t}^F) = \rho + f$.

[22] This is again for tractability; we have $\text{Cov}(r_{i,t}^L, r_{j,t}^L) = c + \rho$, hence $\text{Var}(r_{i,t}^L = \text{Cov}(r_{i,t}^L, r_{j,t}^L) = c + \rho + z$.

and the covariance matrix as:

$$\mu = \left(\begin{array}{c} \chi_1^L + \delta + \gamma_1 \\ \chi_2^L + \delta + \gamma_2 \\ \dots \\ \chi_n^L + \delta + \gamma_n \\ \hline \chi_1^F \\ \dots \\ \chi_n^F \end{array}\right), \text{ and } \Sigma = \left[\begin{array}{cccc|ccc} \rho+c+z & \rho+c & \dots & \rho+c & \rho & \dots & \rho \\ \rho+c & \rho+c+z & \dots & \rho+c & \rho & \dots & \rho \\ \dots & \dots & \dots & \rho+c & \rho & \dots & \rho \\ \rho+c & \rho+c & \dots & \rho+c+z & \rho & \dots & \rho \\ \hline \rho & \rho & \rho & \rho & \rho+f & \dots & \rho \\ \dots & \dots & \dots & \dots & \dots & \dots & \rho \\ \rho & \rho & \rho & \rho & \rho & \rho & \rho+f \end{array}\right] \tag{8}$$

Recall that the solution to the portfolio problem in equation (7) involves the vector $\Sigma^{-1}\mu$, while the remaining terms scale the entire portfolio (Proposition 1). To derive an explicit solution for $\Sigma^{-1}\mu$ under the current assumptions, we make use of a result in linear algebra known as the Sherman-Morrison formula to obtain the inverse Σ^{-1} (Appendix B elaborates). It can be shown that the vector $\Sigma^{-1}\mu$ can be written in the following linear form,

$$\begin{array}{lll} \text{LC bonds:} & w_i^{LC} & \propto & \mu_i^{LC}/z - \sigma^{LC}\overline{\mu}^{LC} - \beta\overline{\mu}^{FC} \\ \text{FC bonds:} & w_i^{FC} & \propto & \mu_i^{FC}/f - \sigma^{FC}\overline{\mu}^{FC} - \beta\overline{\mu}^{LC}, \end{array} \tag{9}$$

where the proportionality ($\propto$) recognises that optimal holdings w_i are proportional to $\Sigma^{-1}\mu$ (see Proposition 1). In (9), μ_i^{LC} denotes the expected return of the local currency bond issued by country i, and $\overline{\mu}^{LC}$ represents the average of expected returns across local currency bonds. The remaining terms are positive constants collecting parameters from the covariance matrix,

$$\begin{aligned} \sigma^{LC} &= n\,\frac{cf + (nc+f)\rho}{\omega z} \\ \sigma^{FC} &= n\,\frac{(nc+z)\rho}{\omega f} \\ \beta &= n\,\frac{\rho}{\omega}, \end{aligned}$$

where ω is a compound variance term, $\omega = \frac{\phi f}{\phi f + (\phi + f)n\rho}$ with $\phi = nc + z$.

Proposition 2. Solution and Comparative Statics

The optimal bond holdings (7) under our return and covariance assumptions give rise to solution (9), with the following characteristics:

- Bond holdings w_i rise in their own **return**, and fall in the return components of competing bonds.
- Holdings fall in a bond's own **variance**, and rise in the variance of other bonds. The **covariance** terms reduce holdings of the respective bonds: ρ lowers all bond holdings, c reduces LC bonds.

- **Exchange rates** affect optimal bond holdings as follows:
  - A drop in δ (increase in BEI) reduces w_i^{LC}, and raises w_i^{FC}, for all i; the absolute change in w_i^{LC} exceeds that in w_i^{FC} in magnitude.
  - A drop in γ_i (increase in BER_i) reduces w_i^{LC} as δ does, but acts on w_i^{LC} whereas δ acts on all local currency bonds.
- The **capital constraint** scales the entire bond portfolio:
  - A tighter **VaR constraint** (an increase in α, e.g. due to an increase in v (BDI)), reduces all bond holdings, w_i^{LC} and w_i^{FC} for all i.
  - Persistent appreciations ($\delta > 0$, $\gamma_i > 0$) induce positive feedback via capital. The appreciation of currency i due to δ raises w_i^{LC} by more than the same amount of idiosyncratic appreciation (γ_i).

Proof: See Appendix B.

The comparative statics indicate which exchange rates matter to global investors. An increase in the BDI ($v \uparrow$) reduces all bond holdings, even for euro-based investors holding local currency bonds denominated in EME currencies. A rise in BEI ($\delta > 0$) reduces local currency bond holdings across the board ($w_i^{LC} \downarrow$). Looking across individual issuers i, the demand for LC bonds is relatively higher for countries with greater expected appreciations against the reference currency ($\gamma_i > 0$, reflecting BER_i); but under-performing currencies may still be held on account of diversification. For the feedback via capital, there is a differential impact between country-specific (γ_i) and generalised (δ) appreciations: both persist into higher expected returns for the next period, but the latter (δ) has a larger effect because it raises local currency returns across the board.

VI. Conclusions

In sum, this paper sheds new light on how international investors adjust their bond holdings in response to different types of exchange rates. By focusing on euro-based investors, we move the reference currency away from the dollar, and are able to identify how investors react to exchange rates referencing the euro without the confounding effects that arise from the dominant role of the dollar in global finance and trade invoicing. To that end, we exploit granular security-level detail on the issuer, the holder and the currency of each bond to define the relevant exchange rates for the currency mismatch on either side.

We find that euro-based investors sell more local currency bonds when EMEs depreciate against the euro, and even more so when individual EMEs depreciate against the euro, precisely those bonds on which their currency mismatch bites. The locus of currency risk we observe is very specific, tied to the lender's balance sheet. When an EME depreciates, the rise in its debt burden may increase credit risk on foreign currency bonds; the same depreciation is inconsequential in terms of servicing local currency debt. Yet we find that investors primarily sell local currency bonds in response to a bilateral depreciation of an EME against the euro. Investors react to the currency mismatch on their *own* balance sheet: the relevant exchange rate is the currency of the bond they hold, not the currency of the issuer country.

Figure 3. **Hedging of EME currencies by Dutch pension funds**

This figure sets the nominal value of EME sovereign debt held by Dutch pension funds (from SHS-S) against the maximum size of their currency hedges, aggregated by region. The latter are computed by aggregating the overall derivatives notional positions in each of the respective EME currencies that pension funds are mandated to report to trade repositories (EMIR). The calculations are based on average quarterly positions in 2021.

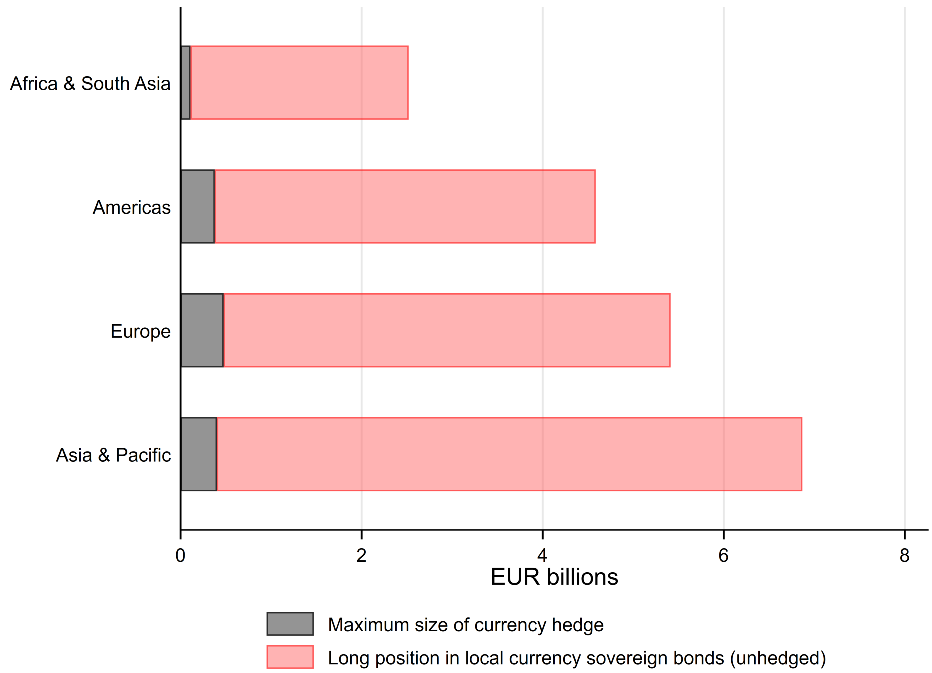
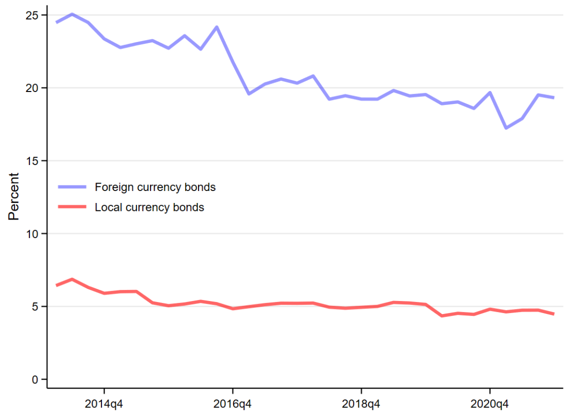
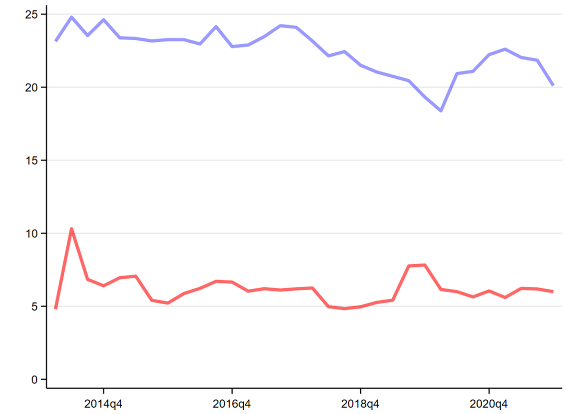


Figure 4. **Fraction of TAO held by EA investors**

This figure shows the fraction of the total amount outstanding (TAO) of EME debt held by euro area investors (in percentage points), separately for local and foreign currency debt. Panel a) shows the results for all securities held by euro area investors (full sample). Panel b) focuses on securities that are in our sample over the entire period 2013q4-2021q4 (balanced sample). The quarterly sample period is 2013q4-2021q4.



(a) Full sample



(b) Balanced sample

Figure 5. **Changes in EME local currency bond holdings - decomposed**

This figure decomposes the changes in EME local currency bonds held by euro area investors in components unique to euro area investors (lenders), EME countries (borrowers), and a common component. The decomposition is based on the algorithm in Amiti and Weinstein (2018). The changes in EME local currency bonds are free of price and currency valuation effects. The borrower and lender components are weighted by total nominal holdings to compute the aggregate change in holdings. The quarterly sample period is 2013q4-2021q4.

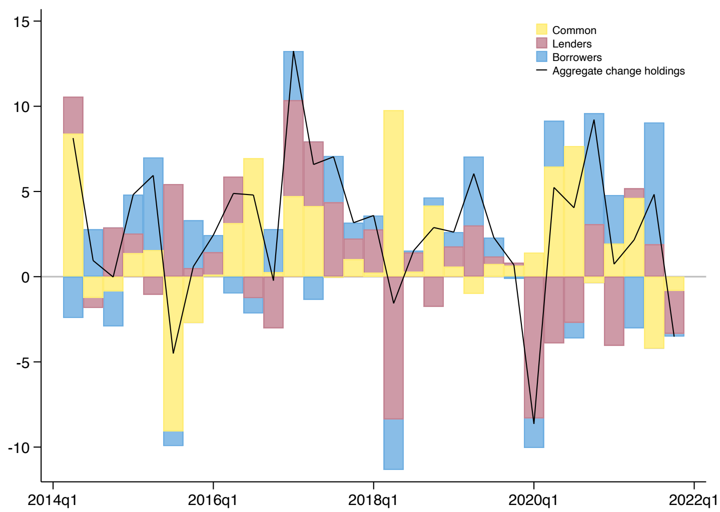


Figure 6. **Heterogeneity in currency exposures across EA countries**

This figure shows the currency exposures for each euro area country. The currency exposure equals: $CE_t^l = \sum_c w_{c,t-1}^l \Delta BER_{c,t}^{€}$, with $w_{c,t-1}^l$ the weight of EME c in investor's l portfolio. The weighted average includes our entire set of 27 EME countries and the quarterly sample period is 2013q4-2021q4.

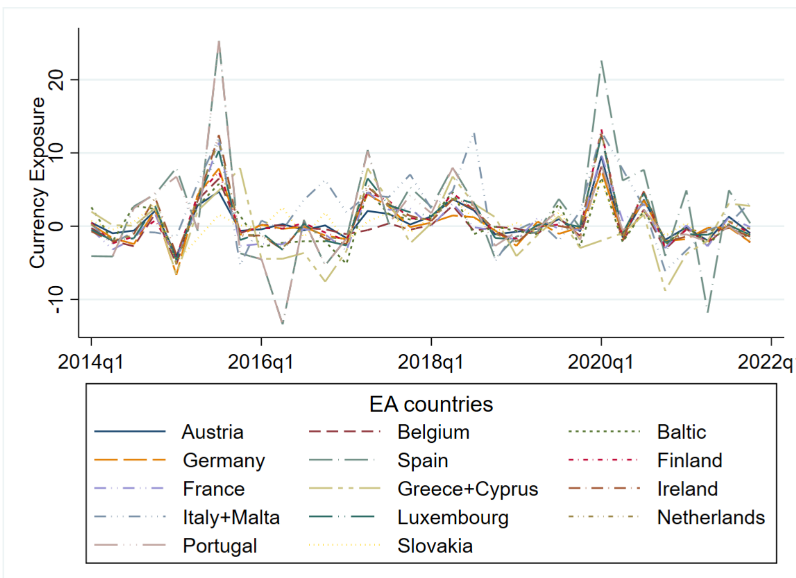


Table 1. **Summary statistics**: This table shows summary statistics for the variables used in the main analysis. Panel A shows variables at the time-level: changes in Broad Dollar Index (BDI), changes in Broad Euro Index (BEI), changes in the VIX, and total amount outstanding (TAO). Panel B shows variables at the country-level: bilateral exchange rates with respect to the euro ($BER^{€}$), GDP, fiscal (net lending/borrowing as % of GDP), inflation, yield differentials (yield on EME country *c* minus German yield), credit ratings, and TAO. Panel C shows variables at the security-level: remaining time to maturity and TAO. TAO, yield differentials, credit ratings, and time to maturity are reported separately for local and foreign currency debt. For foreign currency debt, our analysis is at the country-currency level. BDI, BEI, BERs, VIX, inflation, and yield differentials are in percentage points. TAO is in millions EUR and GDP in billions USD. Fiscal is in percent of GDP. Credit ratings are numerical, and range from 1 (lowest rating) to 21 (highest rating). The quarterly sample period is 2013q4-2021q4.

	mean	std.dev.	p5	p50	p95
Panel A: Time level					
Δ BDI	0.59	2.94	-3.07	0.29	5.26
Δ BEI	0.18	2.27	-2.51	0.38	3.25
Δ VIX	0.06	37.38	-56.50	-13.49	74.07
TAO *domestic*	3397	921	1757	3701	4708
TAO *foreign*	710	199	427	716	1074
Panel B: Country level					
Δ BER €	0.87	5.48	-6.09	0.06	9.02
GDP	1131	2500	64	382	2729
Fiscal	-2.73	3.06	-7.74	-2.50	2.38
Inflation	4.12	6.96	-0.64	2.62	13.53
Yield differential *domestic*	5.12	6.49	0.61	3.52	11.96
Yield differential *foreign*	3.29	3.32	0.36	3.05	6.75
Credit rating *domestic*	12.92	3.43	8	12	19
Credit rating *foreign*	12.10	3.47	6	12	17
TAO *domestic*	131	222	5	59	571
TAO *foreign*	38	39	2	25	119
Panel C: Security level					
Time to maturity *domestic*	7.27	7.51	0.44	4.81	23.89
Time to maturity *foreign*	11.73	16.42	0.71	7.34	29.58
TAO *domestic*	3	5	0	2	12
TAO *foreign*	1	2	0	1	3

Table 2. **Correlation table**: This table shows the correlation table of the main variables introduced in Table 1. For all variables, we take log changes to construct the correlation table. The quarterly sample period is 2013q4-2021q4.

Correlation table										
Δ BDI	1.00									
Δ BEI	-0.36	1.00								
Δ BER €	0.00	0.42	1.00							
Δ VIX	0.42	0.16	0.18	1.00						
Δ TAO	0.00	0.02	-0.01	-0.04	1.00					
Δ Yield diff	0.12	-0.04	0.29	0.05	0.03	1.00				
Δ credit rating	0.00	0.01	0.01	0.02	-0.04	-0.25	1.00			
Δ GDP	-0.54	0.12	-0.54	-0.19	0.01	-0.18	0.07	1.00		
Δ Fiscal	0.10	-0.19	-0.11	-0.10	0.00	0.05	0.04	0.08	1.00	
Δ Inflation	-0.06	-0.02	0.12	-0.01	-0.03	0.06	0.08	0.04	0.04	1.00

Table 3. **Time-series regressions**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI) and the Broad Euro Index (BEI). Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amount outstanding (TAO), and the change in the VIX. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the foreign-local level and reported in brackets. Significance: ***99%, **95%, *90%.

	All	Domestic	Foreign
ΔBDI	-0.842***	-1.170***	-0.499***
	[0.147]	[0.258]	[0.165]
ΔBEI	-0.475***	-0.783***	-0.098
	[0.171]	[0.265]	[0.145]
ΔTAO	0.004	-0.252	0.15
	[0.232]	[0.634]	[0.090]
ΔVIX	0.001	0.006	-0.003
	[0.010]	[0.015]	[0.010]
Constant	2.637***	3.884**	1.981***
	[0.489]	[1.813]	[0.350]
N	64	32	32
R-sq	0.31	0.36	0.51

Table 4. **Panel regressions at the country level**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and EME bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$). Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation. Country and country-currency fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the country-currency level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI			BDI vs $BER^{€}$			BDI vs BEI vs $BER^{€}$		
	All	**Local**	**Foreign**	**All**	**Local**	**Foreign**	**All**	**Local**	**Foreign**
ΔBDI	-0.944***	-1.245***	-0.549**	-0.883***	-1.119***	-0.471	-1.000***	-1.258***	-0.591**
	[0.200]	[0.297]	[0.266]	[0.215]	[0.297]	[0.354]	[0.211]	[0.307]	[0.282]
ΔBEI	-0.533**	-0.860***	-0.123				-0.553**	-0.861***	-0.147
	[0.227]	[0.292]	[0.327]				[0.230]	[0.294]	[0.331]
$\Delta BER^{€}$				-0.210**	-0.268*	0.033			
				[0.095]	[0.157]	[0.199]			
$\Delta BER^{€,ort}$							-0.129	-0.029	-0.105
							[0.098]	[0.174]	[0.107]
ΔTAO	0.444***	0.217***	0.621***	0.446***	0.210***	0.623***	0.443***	0.217***	0.620***
	[0.064]	[0.069]	[0.092]	[0.064]	[0.069]	[0.092]	[0.064]	[0.069]	[0.092]
Δ Yield diff	0.17	-0.388	0.767	0.225	-0.231	0.763	0.22	-0.37	0.783
	[0.239]	[0.254]	[0.491]	[0.239]	[0.274]	[0.491]	[0.248]	[0.280]	[0.495]
ΔVIX	0.012	0.022	-0.008	0.005	0.012	-0.011	0.013	0.022	-0.007
	[0.012]	[0.016]	[0.017]	[0.012]	[0.017]	[0.017]	[0.012]	[0.016]	[0.017]
ΔCredit rating	0.592	-3.525	2.034	0.685	-3.09	1.979	0.74	-3.475	2.109
	[1.428]	[2.275]	[1.422]	[1.421]	[2.339]	[1.428]	[1.418]	[2.354]	[1.400]
Δ GDP	-0.012	-0.004	0.013	-0.045	-0.13	0.018	-0.067	-0.019	-0.026
	[0.062]	[0.097]	[0.080]	[0.068]	[0.137]	[0.082]	[0.083]	[0.132]	[0.105]
Δ Fiscal	-0.462	0.299	-0.898	-0.313	0.541	-0.846	-0.436	0.302	-0.867
	[0.643]	[0.965]	[0.839]	[0.635]	[0.962]	[0.823]	[0.644]	[0.965]	[0.843]
Δ Inflation	-0.232	0.177	-0.368	-0.14	0.376	-0.351	-0.175	0.191	-0.328
	[0.318]	[0.542]	[0.378]	[0.319]	[0.563]	[0.376]	[0.325]	[0.568]	[0.381]
Country FE	No	Yes	No	No	Yes	No	No	Yes	No
Country-curr FE	Yes	–	Yes	Yes	–	Yes	Yes	–	Yes
N	1751	779	972	1751	779	972	1751	779	972
R-sq	0.17	0.09	0.28	0.16	0.08	0.28	0.17	0.09	0.28

Table 5. **Panel regressions at the security level**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and EME bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$). Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation, and the remaining time-to-maturity (of security s, TTM). Security fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the security level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI			BDI vs $BER^{€}$			BDI vs BEI vs $BER^{€}$		
	All	**Local**	**Foreign**	**All**	**Local**	**Foreign**	**All**	**Local**	**Foreign**
ΔBDI	-0.600***	-0.671***	-0.469***	-0.693***	-0.660***	-0.476***	-0.629***	-0.691***	-0.493***
	[0.076]	[0.096]	[0.115]	[0.078]	[0.098]	[0.136]	[0.079]	[0.100]	[0.118]
ΔBEI	-0.161**	-0.278***	0.083				-0.171**	-0.284***	0.074
	[0.081]	[0.104]	[0.119]				[0.082]	[0.105]	[0.120]
$\Delta BER^{€}$				-0.179***	-0.114**	0.03			
				[0.043]	[0.056]	[0.097]			
$\Delta BER^{€,ort}$							-0.053	-0.143**	-0.032
							[0.042]	[0.067]	[0.052]
ΔTAO	0.285***	0.278***	0.287***	0.285***	0.277***	0.287***	0.285***	0.278***	0.287***
	[0.017]	[0.018]	[0.039]	[0.017]	[0.018]	[0.039]	[0.017]	[0.018]	[0.039]
Time-to-maturity	1.907***	2.481***	0.847***	1.901***	2.479***	0.848***	1.905***	2.481***	0.843***
	[0.094]	[0.129]	[0.126]	[0.094]	[0.129]	[0.126]	[0.094]	[0.129]	[0.126]
Δ Yield diff	0.087	-0.434***	0.434***	0.13	-0.353**	0.437***	0.105	-0.403**	0.439***
	[0.095]	[0.168]	[0.114]	[0.095]	[0.176]	[0.114]	[0.097]	[0.179]	[0.115]
ΔVIX	-0.003	0.001	-0.016**	-0.002	-0.002	-0.015**	-0.003	0.001	-0.016**
	[0.005]	[0.006]	[0.007]	[0.004]	[0.006]	[0.007]	[0.005]	[0.006]	[0.007]
ΔCredit rating	-2.153***	-3.119***	-1.362**	-1.926***	-2.897***	-1.338**	-2.091***	-3.036***	-1.324**
	[0.475]	[0.839]	[0.581]	[0.479]	[0.849]	[0.582]	[0.479]	[0.851]	[0.587]
Δ GDP	0.034	0.074**	-0.04	-0.012	0.03	-0.043	0.007	0.056	-0.06
	[0.024]	[0.036]	[0.032]	[0.025]	[0.041]	[0.032]	[0.031]	[0.042]	[0.042]
Δ Fiscal	-0.115	-0.227	0.116	-0.104	-0.168	0.09	-0.107	-0.231	0.133
	[0.263]	[0.348]	[0.362]	[0.261]	[0.347]	[0.356]	[0.264]	[0.348]	[0.363]
Δ Inflation	0.314***	0.062	0.416***	0.334***	0.106	0.416***	0.330***	0.083	0.424***
	[0.093]	[0.179]	[0.105]	[0.093]	[0.181]	[0.105]	[0.097]	[0.179]	[0.115]
Security FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	43824	29916	13908	43824	29916	13908	43824	29916	13908
R-sq	0.13	0.13	0.1	0.13	0.13	0.1	0.13	0.13	0.1

Table 6. **Robustness - Advanced economies**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$). The sample includes major advanced economies outside of the euro area and excluding the United States, namely Australia, Canada, Denmark, Japan, Norway, New Zealand, Sweden, Switzerland and the United Kingdom. As these countries primarily issue debt in their own currencies, we show the results for local currency bonds only. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation, and the remaining time-to-maturity (of security s). Security fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the security level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI	BDI vs $BER^{€}$	BDI vs BEI vs $BER^{€}$
	Local	**Local**	**Local**
ΔBDI	-0.111	-0.274***	-0.263***
	[0.087]	[0.098]	[0.098]
ΔBEI	-0.370***		-0.390***
	[0.101]		[0.101]
$\Delta BER^{€}$		-0.338***	
		[0.074]	
$\Delta BER^{€,ort}$			-0.273***
			[0.086]
Controls	Yes	Yes	Yes
Security FE	Yes	Yes	Yes
N	39568	39568	39568
R-sq	0.07	0.07	0.07

Table 7. **Robustness - EMEs borrowing euro**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and EME bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$), *excluding* the following EMEs: Bulgaria, Croatia, Czech Republic, Hungary, Poland, and Romania. Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation, and the remaining time-to-maturity (of security s). Security fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the security level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI			BDI vs $BER^{€}$			BDI vs BEI vs $BER^{€}$		
	All	**Local**	**Foreign**	**All**	**Local**	**Foreign**	**All**	**Local**	**Foreign**
ΔBDI	-0.611***	-0.670***	-0.493***	-0.709***	-0.658***	-0.401**	-0.634***	-0.691***	-0.504***
	[0.082]	[0.101]	[0.129]	[0.084]	[0.103]	[0.168]	[0.085]	[0.105]	[0.132]
ΔBEI	-0.197**	-0.272**	-0.036				-0.207**	-0.281**	-0.041
	[0.088]	[0.110]	[0.137]				[0.089]	[0.111]	[0.137]
$\Delta BER^{€}$				-0.186***	-0.105*	0.067			
				[0.044]	[0.057]	[0.117]			
$\Delta BER^{€,ort}$							-0.039	-0.041	-0.015
							[0.044]	[0.068]	[0.054]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	36674	25903	10771	36674	25903	10771	36674	25903	10771
R-sq	0.13	0.13	0.1	0.13	0.13	0.1	0.13	0.13	0.1

Table 8. **Robustness - Currency of bond vs issuer**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and EME bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$), using bilateral euro rates with respect to the *issuer country*. Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation, and the remaining time-to-maturity (of security s). Security fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the security level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI			BDI vs $BER^{€}$			BDI vs BEI vs $BER^{€}$		
	All	**Local**	**Foreign**	**All**	**Local**	**Foreign**	**All**	**Local**	**Foreign**
ΔBDI	-0.656***	-0.671***	-0.538***	-0.402***	-0.660***	-0.048	-0.482***	-0.691***	-0.139
	[0.076]	[0.096]	[0.116]	[0.078]	[0.098]	[0.122]	[0.080]	[0.100]	[0.124]
ΔBEI	-0.109	-0.278***	0.227*				-0.061	-0.284***	0.333***
	[0.082]	[0.104]	[0.122]				[0.082]	[0.105]	[0.122]
$\Delta BER^{€}$				0.207***	-0.114**	0.499***			
				[0.039]	[0.056]	[0.062]			
$\Delta BER^{€,ort}$							0.303***	-0.143**	0.542***
							[0.044]	[0.067]	[0.068]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	43824	29916	13908	43824	29916	13908	43824	29916	13908
R-sq	0.13	0.13	0.16	0.13	0.13	0.16	0.13	0.13	0.16

Table 9. **Robustness - Investment funds and custodians**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and EME bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$), *excluding* the following holder countries: Belgium, Luxembourg, and Ireland. Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation, and the remaining time-to-maturity (of security s). Security fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the security level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI			BDI vs $BER^{€}$			BDI vs BEI vs $BER^{€}$		
	All	**Local**	**Foreign**	**All**	**Local**	**Foreign**	**All**	**Local**	**Foreign**
ΔBDI	-0.713***	-0.912***	-0.338***	-0.750***	-0.853***	-0.467***	-0.753***	-0.921***	-0.387***
	[0.083]	[0.108]	[0.119]	[0.084]	[0.109]	[0.139]	[0.086]	[0.112]	[0.122]
ΔBEI	-0.322***	-0.536***	0.095				-0.336***	-0.539***	0.076
	[0.090]	[0.119]	[0.123]				[0.090]	[0.119]	[0.124]
$\Delta BER^{€}$				-0.190***	-0.175***	-0.091			
				[0.046]	[0.061]	[0.101]			
$\Delta BER^{€,ort}$							-0.072	-0.019	-0.068
							[0.045]	[0.073]	[0.054]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	40240	26516	13724	40240	26516	13724	40240	26516	13724
R-sq	0.13	0.13	0.09	0.13	0.13	0.09	0.13	0.13	0.09

Table 10. **Lender-specific component and currency exposures**: This table shows the results of regressions of the lender-specific component of changes in holdings on euro area country specific currency exposures: $CE_t^l = \sum_c w_{c,t-1}^l \Delta BER_{c,t}^{€}$, with $w_{c,t-1}^l$ the weight of EME c in investor's l portfolio. Standard errors are clustered at the euro area country level and reported in brackets. Significance: ***99%, **95%, *90%.

Panel A: Euro area country specific BER				
	Equally weighted		**Value weighted**	
ΔCE	-0.4680**	-0.5592**	-0.2840**	-0.2731*
	[0.2005]	[0.2604]	[0.1276]	[0.1295]
Constant	2.4845*	2.5561***	2.0050*	1.9958***
	[1.3437]	[0.2045]	[0.9545]	[0.1085]
Lender FE	No	Yes	No	Yes
N	460	460	460	460
R-sq	0.0055	0.0442	0.0042	0.0761
Panel B: Broad Euro Index				
	Equally weighted		**Value weighted**	
Δ BEI	-0.5403	-0.6221	-0.2267	-0.2042
	[0.3745]	[0.4109]	[0.1976]	[0.1707]
Constant	2.1671*	2.1747***	1.7783*	1.7772***
	[1.2136]	[0.0382]	[0.9400]	[0.0085]
Lender FE	No	Yes	No	Yes
N	460	460	460	460
R-sq	0.002	0.0392	0.0007	0.0729

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Appendix

A. The AW decomposition

The AW decomposition links the growth in nominal amounts held by lenders from country l to EME country c to a "lender component" (α_t^l) unique to lender l and a "EME-country component" ($\beta_{c,t}$) affecting all euro area investors in EME c. These components are time-varying fixed effects that break down the total growth variation across euro area investors and EMEs over time as follows (we leave out the subscript d for ease of exposition):

$$\frac{N_{c,t}^l - N_{c,t-1}^l}{N_{c,t-1}^l} = \alpha_t^l + \beta_{c,t} + \epsilon_{l,c,t}. \tag{10}$$

The AW decomposition breaks down Equation (10) into the "common component" γ_t, median growth in lending (of all $l - c$ pairs), a lender component $\tilde{\alpha}_t^l$, and a borrower component $\tilde{\beta}_{c,t}$, where tildes indicate deviations from γ_t. AW show that the decomposition is exact, as the three components sum to overall growth.

B. Sketch of Proof of Proposition 2

This appendix derives the explicit solution for $\Sigma^{-1}\mu$ underpinning Proposition 2. Recall equation (8) and the assumptions preceding it. The covariance matrix Σ can be written in an additive form, where a constant shift matrix ρ is added to the the "core correlation matrix" S,

$$\Sigma = S + \rho\ uu^T, \text{ where}$$

and u is a conformable vector of ones, so the outer product uu^T is a matrix of ones. This form allows us to find the inverse by means of the Sherman-Morrison formula (Bartlett 1951): a matrix of the form $B = A + uv^T$ has an inverse with a similar structure,

$$B^{-1} = A^{-1} - \frac{A^{-1}uv^TA^{-1}}{1 + v^TA^{-1}u}.$$

Applied to Σ, we have $v = \rho\, u$, and A equals:

$$S = \begin{bmatrix} S_{LC} & 0 \\ 0 & S_{FC} \end{bmatrix},$$

where S_{FC} is a diagonal matrix $f\, I_n$ and S_{LC} itself is of the Sherman-Morrison form,

$$S_{LC} = z\, I_n + c\ \iota\iota^T,$$

where ι is an n-vector of ones. With this, the inverse Σ^{-1} can be found by:

$$\begin{aligned}\Sigma^{-1} &= S^{-1} - \frac{\rho\, S^{-1} u\, u^T S^{-1}}{1 + u^T S^{-1} u}, \text{ with} \\ S^{-1} &= \begin{bmatrix} S_{LC}^{-1} & 0 \\ 0 & S_{FC}^{-1} \end{bmatrix},\end{aligned}$$

where $S_{FC}^{-1} = I_n/f$ and S_{LC}^{-1} can itself be found via the Sherman-Morrison formula.

Deriving the general solution for any n follows four steps: (1) Invert S, (2) compute the scalar $1 + u^T S^{-1} u$, (3) calculate the shift matrix $\rho\, S^{-1} u v^T S^{-1}$, and (4) combine those elements in the Sherman-Morrison formula.

Special cases. When there is no correlation across LC and FC bonds ($\rho = 0$), the inverse Σ^{-1} reduces to the inverse of S, the core correlation matrix. Another special case of interest is that of equal expected returns across LC bonds ($\delta_i = \delta$).

C. Additional Tables

Table 11. **Panel regressions at the borrower-lender level**: This table reports regressions of quarterly changes in foreign holdings (log nominal amounts) on log changes in the Broad Dollar Index (BDI), Broad Euro Index (BEI), and EME bilateral exchange rates against the euro ($BER^{€}$) and the same bilateral exchange rates orthogonalized with respect to the BEI ($BER^{€,ort}$) at the borrower-lender level. Column headings indicate whether the sample includes bonds denominated in all, in local or in foreign currencies (from the perspective of the EME sovereign). For foreign currency debt, our analysis is at the country-currency level. Controls include the change in log total amounts outstanding, credit ratings, yield differentials, VIX, GDP, fiscal, and inflation, and the remaining time-to-maturity (of security s). Security fixed effects are included as reported. The quarterly sample period is 2013q4-2021q4. Standard errors are clustered at the security level and reported in brackets. Significance: ***99%, **95%, *90%.

	BDI vs BEI			BDI vs $BER^{€}$			BDI vs BEI vs $BER^{€}$		
	All	**Local**	**Foreign**	**All**	**Local**	**Foreign**	**All**	**Local**	**Foreign**
ΔBDI	-0.446***	-0.597***	-0.269**	-0.505***	-0.606***	-0.189	-0.487***	-0.661***	-0.267*
	[0.113]	[0.195]	[0.137]	[0.117]	[0.204]	[0.155]	[0.116]	[0.204]	[0.141]
ΔBEI	-0.200*	-0.424**	0.021				-0.214*	-0.427**	0.022
	[0.120]	[0.203]	[0.148]				[0.120]	[0.203]	[0.149]
$\Delta BER^{€}$				-0.178***	-0.204*	0.127			
				[0.068]	[0.110]	[0.120]			
$\Delta BER^{€,ort}$							-0.095	-0.136	0.006
							[0.067]	[0.128]	[0.079]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower-Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	23129	7753	15376	23129	7753	15376	23129	7753	15376
R-sq	0.04	0.03	0.06	0.04	0.03	0.06	0.04	0.03	0.06