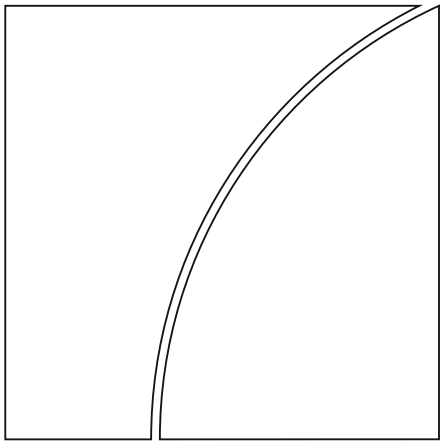

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by Carol Bertaut, Valentina Bruno and Hyun Song Shin

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JEL classification: F65, G23, H63.

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Original Sin Redux: Role of Duration Risk*

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March 16, 2025

Abstract

We highlight the role of duration and exchange rate risks on portfolio flows by using a unique and comprehensive database of US investor flows into emerging market government bonds denominated in local currency. Borrowing long-term mitigates rollover risk but amplifies valuation changes that further interact with currency movements. Our analysis highlights the double-edged nature of long-term borrowing and draws attention to market stress dynamics due to strategic complementarities among mutual fund investors.

Keywords: local currency bonds, duration risk, strategic complementarity, nonbank financial intermediaries

JEL codes: F65, G23, H63

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1 Introduction

Historically, many emerging market economies (EMEs) that borrowed from abroad were confined to doing so only in foreign currency. Eichengreen and Hausmann (1999) called the phenomenon "Original Sin", highlighting what appeared to be the perpetual dependence of these economies on foreign currency borrowing, especially that denominated in US dollars. However, since the emerging market crises of the 1990s, the share of government debt in foreign currency has fallen significantly. Domestic capital markets deepened in emerging markets and importantly, global portfolio investors took a greater share of local currency-denominated sovereign bonds (Du and Schreger, 2016).

Overcoming Original Sin reduced vulnerabilities associated with currency mismatches and highlighted the benefits of financial globalization (Obstfeld, 2009). Nevertheless, currency risk was shifted from borrowers to investors rather than eliminated altogether. Carstens and Shin (2019) coined the term "Original Sin Redux" to denote this shift.

In this paper, we explore the consequences of this reallocation of risk in global capital markets with a focus on the mutually reinforcing nature of the interaction of currency risk with *duration risk* on local currency sovereign bonds. Our analysis highlights the double-edged nature of long-term borrowing and how duration risk figures in the market dynamics of emerging market sovereign bonds.

Duration and currency risks are borne by investors in the first instance, but since long-term interest rates and the sovereign yield curve underpin domestic financial conditions, the borrowing country ultimately bears the macro risks through tighter domestic financial conditions. In this way, duration risk faced by investors serves as another channel of transmission of global financial conditions to the domestic economy, even when the borrower has overcome Original Sin. Borrowing in domestic currency has clear benefits, but turns out not to be a panacea.

Figure 1 gives a flavor of the analysis to follow by means of a snapshot of the March 2020 stress episode. Figure 1 shows the average monthly net purchases of EME sovereign bonds in 16 countries by investors in the United States, expressed as a percentage of holdings. The bonds are partitioned into two groups of issuing countries: those where US investors

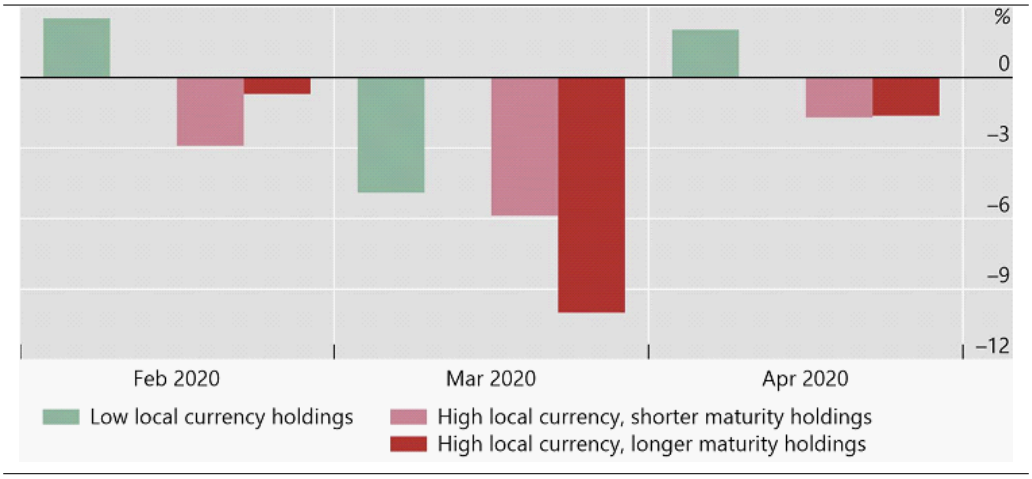


Figure 1: **March 2020 Episode.** This figure shows the average of the net purchases of sovereign bonds as percent of holdings by US investors from February 2020 to May 2020 for a sample of 16 EMEs. The sub-sample "Low Local currency holdings" consists of countries below the median of the US local currency holdings to total US holdings ratio (Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia, and Turkey). The sub-sample "High Local currency holdings" consists of countries above the median of the US local currency holdings to total US holdings ratio (Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, and Thailand). The bonds of the eight countries with "High Local currency holdings" are further split into two subsets, bonds with longer ("High Local currency holdings, longer maturity holdings") vs. shorter remaining maturity ("High Local currency holdings, shorter maturity holdings").

hold bonds mostly denominated in the local currency of the borrower (High Local currency holdings) and those where US investors mostly hold government bonds denominated in US dollars (Low Local currency holdings). The "High Local" sample of bonds is further split between bonds with shorter versus longer remaining maturity.

The figure draws attention to two key features. First, it is the countries where US investors hold local currency bonds that saw the larger portfolio outflows in March 2020 when the dollar appreciated sharply, contrary to the received wisdom that currency mismatch on the part of the borrower is the source of emerging market woes. Second, and importantly, investors' outflows were larger where they faced greater duration risk due to longer bond maturities. The picture is a vivid illustration of the role of duration risk coupled with exchange rate fluctuations in determining the overall outcome in international capital markets.

Our paper is structured in two parts. In the first, we undertake a cross-sectional study of different investor sectors regarding the sensitivity of their portfolio holdings to fluctuations in financial conditions, as measured by shifts in the broad US dollar index. Our sample of

destination countries covers 16 major emerging market economies for the period 2004 to 2022. In the second part of the paper, we delve deeper and identify *strategic complementarities* among investors as a key mechanism behind our findings. We draw lessons on the financial stability implications of the interaction between currency risk and duration risk.

In contrast to most existing studies of EME portfolio flows that focus only on mutual funds due to data availability, we are able to cast the net much wider by drawing on a unique and comprehensive dataset of portfolio flows of *all* US investor sectors - the Treasury International Capital (TIC). Without a better understanding of whether mutual fund flows are representative of the portfolio flows at the aggregate level, broader questions relevant for a macro assessment are difficult to address adequately. Our data overcomes that particular shortcoming. The TIC dataset also allows us to measure directly the shifts in holdings rather than relying on inferred holdings from the fund redemption flows.

We highlight two main findings. First, duration risk emerges as a key channel for the transmission of market conditions in portfolio flows. Emerging market sovereigns have joined the trend of borrowing at longer maturities taking advantage of low long-term yields during the low-for-long period of monetary policy. While issuing longer maturity bonds mitigates rollover risk for the borrowers, longer maturity bonds come with greater duration risk for the investor whereby a given yield change is associated with a larger percentage price change. Fluctuations in market values due to duration risk, rather than traditional vulnerabilities due to currency mismatch or maturity mismatch, take center stage in stress dynamics.

Duration risk is particularly potent due to its interaction with currency risk. Our working hypothesis (consistent with industry practice) is that investors in emerging market local currency bonds do not pre-hedge the currency risk when entering the local currency bond market, and instead aim to benefit from a stronger local currency even as the yields fall. However, when market sentiment turns amid dollar appreciation, the withdrawal from risk-taking finds expression in the shedding of exposures**.** Just as investors "win twice" during periods of EM currency appreciation amid falling yields, they "lose twice" when the cycle turns. In this process, currency risk injects a "wind chill" effect that amplifies the losses from the increase in yields. It is therefore the interaction between currency and duration risk that

plays a key role in the cycle between risk-on and risk-off.

Our second notable finding is that not all investor sectors are alike. Among the universe of all investors, mutual funds stand out as the investor sector that is most sensitive to duration and currency risk. At the fund level, we show that mutual funds substantially reduce their holdings of EM local currency bonds following dollar appreciation, and do so much more for longer maturity bonds. Higher duration bonds also exhibit a greater yield response to sales. Taken together, sales of higher duration bonds generate larger negative spillovers on the remaining investors, sharpening remaining fund investors' incentive to join the run. In short, the first-mover advantage in the redemption decision is larger for funds holding longer maturity bonds. Through this exercise, we identify the "double whammy" of duration and currency risk as the key mechanism that amplifies the flows out of funds with longer maturity holdings.

The greater sensitivity of mutual fund outflows to shifts in financial conditions echoes the arguments in Chen, Goldstein and Jiang (2010) and Goldstein, Jiang, and Ng (2017), who relate the flow dynamics to extent of strategic complementaries and financial fragilities, as well as Falato, Goldstein, and Hotacsu (2021), who highlight the role of open-ended bond funds during the COVID-19 stress episode of March 2020. Specifically, Goldstein, Jiang, and Ng (2017) look at US corporate bond mutual funds and find that strategic complementarities among corporate-bond-fund investors are more severe during periods of higher illiquidity.

In our context, the local currency bond market turns out to be a particularly apt setting to test the strategic complementarity hypothesis. Just as illiquidity amplifies redemption risk in Chen et al.'s (2010) global game framework, we find that exchange rate fluctuations amplify duration risk for global portfolio investors who evaluate returns in dollar terms. By transposing the Chen et al. (2010) micro-level fragility model to a macrofinancial context, we shed light on how currency risk interacts with duration risk to generate financial instability. Our findings are also in keeping with the phenomenon of "liquidity black holes" where stress is amplified from the endogenous responses of the market participants themselves (Morris and Shin, 2004). When asset prices fall, recoiling from risk can result in market distress feeding on itself.

Our findings carry broader macro implications. The post-GFC period of low-for-long interest rates has resulted in the terming out of bond issuance, with greater share of issuance taken up by long maturity bonds. Given the prevalence of mutual funds in emerging market capital markets, our results suggest substantial macro effects during periods of dollar strength. In markets where global investors account for a large share of the investor base, dollar appreciation can drive substantial outflows from longer-maturity, local-currency sovereign bonds, ultimately driving domestic yields higher.

Furthermore, our findings underline the importance of looking at flows of all investor sectors. Mutual funds are not representative of investors as a group; they tend to exhibit much greater sensitivity to shifts in financial conditions. In contrast, other investors, such as pension funds or insurers, exhibit lower sensitivity to these changes and tend to maintain steady portfolios. We also observe important differences in how the same type of investor behaves across currencies (local currency vs. USD) and maturities. The mutual fund footprint in the dollar-denominated bond market is smaller than in the local currency bond market.

Importantly, our findings reveal the significance of Original Sin Redux for emerging markets. When EMEs issue in local currency, risk does not disappear, but shifts to global investors, who must manage currency movements alongside underlying local currency returns. These findings add an important qualification to the prescription to issue longer-maturity debt to reduce vulnerabilities. The double-edged nature of long-term borrowing injects new vulnerabilities associated with market risk due to higher duration.

Our analysis carries implications well beyond emerging markets. For instance, the importance of duration risk for stress dynamics was a central theme in the September 2022 turmoil in UK gilts. At the macro level, our results contribute to the important recent discussion on the role of non-bank financial intermediaries (NBFIs) in stress propagation and financial instability in an era when financial intermediation has increasingly shifted from the banking sector to the NBFI sector (see, for instance, Buch and Goldberg, 2023, for a review).

1.1 Related Literature

In 1999 Eichengreen and Hausmann coined the term Original Sin, defined as the inability of EMEs to borrow abroad in their own currency, mostly related to their economic sizes. Burger and Warnock (2007) and Burger et al. (2015) argued that once inflation was under control and in the presence of strong institutions, EMEs were able to borrow in their local currency. They suggest that not being able to borrow in domestic currency was "sin, but not original", because many EMEs have overcome the sin and improved foreign participation by reducing macroeconomic instability. Relatedly, Engel and Park (2022) show that original sin can be mainly attributed to a country's monetary indiscipline: a country with less disciplined monetary policy borrows mainly in foreign currency as a substitute for monetary credibility. Devereux and Wu (2022) also show that foreign exchange reserves can mitigate original sin by reducing risks for foreign investors. In a recent update, Eichengreen, Hausmann, and Panizza (2023) show that Original Sin continues to persist in low-income countries, and it remains more difficult for small developing countries to issue domestic currency debt. In contrast, middle-income EMEs have made progress in placing local currency debt with international investors.

Our study is also related to the sovereign debt literature that has highlighted the role of foreign investors. Du and Schreger (2016) show that EME local currency bonds became an important asset class for global investors, but foreign participation in EME local markets appears to have plateaued in recent years. Du, Pflueger, and Schreger (2020) illustrate a large heterogeneity across emerging markets in terms of riskiness (duration and currency risk) of local currency government bonds. Fang, Hardy, and Lewis (2023) construct an aggregate data set of sovereign debt holdings by foreign and domestic bank, non-bank private, and official investors for a large number of countries over 20 years. They find that non-bank investors, mainly investment funds, increase their holdings of sovereign debt by more than other investors, and they are the most responsive to changes in sovereign yields, while Chari, Dilts Stedman and Lundblad (2022) find that tail risk in EMEs is influenced by investors' mechanical rebalancing in response to global risk shocks.

A few studies focus on euro area investors. Faia, Lewis, and Zhou (2024) look at monetary

policy spillovers and find that Euro area investors such as investment funds rebalance their portfolio away from EMEs in response to a surprise monetary tightening. Zhou (2024) highlights the role that investor composition plays in driving or amplifying the global financial cycle. Jansen, Shin, and von Peter (2024) find that euro-based investors respond differently to various exchange rates and currency mismatches, and Boermans and Burger (2023) find that euro area investors sell when the dollar appreciates.

Our study is also related to the literature on capital flows and exchange rates. Bruno and Shin (2015a) define the financial channel of exchange rate, which works through shifts in the effective credit risk faced by financial intermediaries. When the local currency appreciates, local borrowers' balance sheets become stronger, resulting in lower credit risk and hence expanded lending capacity through a value at-risk (VaR) constraint. In this way, currency appreciation leads to greater risk-taking. Bruno and Shin (2015b) analyze the role of the US dollar as a barometer of global financial conditions that get transmitted across borders, whereby fluctuations in financial conditions arise from shifts in the risk appetite of global investors.

Along those lines, Camanho, Hau, and Rey (2022) show that exchange rate fluctuations elicit global investors' portfolio rebalancing aimed at mitigating the risk exposure changes due to price and exchange rate changes. Maggiori, Neiman, and Schreger (2020) use holdings of mutual funds to establish that currency is an important factor shaping global portfolios. Hofmann, Patel, and Wu (2022) provide conceptual support for our empirical evidence based on a new keynesian model, highlighting the critical role of balance sheet constraints on the lenders' side. Lee (2022) finds that EM sovereigns borrow more in foreign currency when exchange rate volatility is higher because international investors charge a high exchange rate risk premium on emerging market local currency debt.

The novelty of our study compared to previous research is addressing the role of duration risk in Original Sin Redux, pinpointing the economic channel at play and how exchange rates set the tone for market trading. When EMEs issue in local currency, risk does not disappear, but it is borne by global investors. During periods of financial stress, portfolio outflows go hand-in-hand with rising yields and a depreciating currency (Hofmann, Shim, and Shin,

2020) as dollar-based investors "lose twice".

Our study establishes that strategic complementarities form the core mechanism of the "redux" in Original Sin Redux. Mutual funds display heightened sensitivity to duration risk and exchange rate changes, showing the greatest redemption activity. This magnifies price reactions and generates larger outflows from local currency bonds when the dollar appreciates. This mechanism lies behind the transmission channel for global financial conditions to affect domestic economies, even when borrowers have overcome the original version of Original Sin.

2 Dataset

We use the confidential micro-level TIC data for the United States on cross-border portfolios. The comprehensive coverage of our dataset allows us to study the comparative portfolio choice across all investor types and answer novel research questions that elude traditional databases. We use both the underlying security-level data from the annual surveys by the US Treasury on the portfolio holdings of US-resident investors of foreign securities, as well as the aggregate monthly portfolio data (see Bertaut and Judson, 2014; 2022). The dataset from the annual surveys allows disaggregation by country, currency, borrowing sector, and maturity, whereas the monthly data allow higher frequency analysis by country.

In the TIC annual data, holdings of individual bonds (by holder type) are reported at market value as of the end of the year. For each bond held, we also know the bond's price at year-end as well as the exchange rate, and thus we can "deflate" market values by price and exchange rates to adjust for valuation gains or losses arising from changes in yields and exchange rates. In this way, we can obtain actual investor purchases or sales. We then aggregate the notional holdings by investor type, country, and currency type, and compute annual flows as the change in notional holdings expressed as the share of the prior year holdings. By aggregating, we can account for any changes in holdings arising from bonds that are issued in or mature in a given year. Such an aggregation allows for more accurate estimation of the entirety of portfolio flows within the year. The sample period is 2004-2022 and we exclude 2022 bond flows data of Russia due to frozen assets sanctions.

Our dataset has at least two advantages relative to other sources used in the literature.

First, previous studies of portfolio flows have mostly focused on mutual fund flows due to data limitations on other investor types. In contrast, the comprehensive nature of our dataset allows us to study the comparative portfolio decisions across seven investor sectors.

Second, and relatedly, our dataset allows us to measure directly the shifts in the underlying portfolios rather than having to infer the portfolio adjustments indirectly from the fund redemption flows. The shifts in the underlying asset holdings of mutual funds depend not only on the redemption flows of mutual fund investors, but also on the additional portfolio adjustments due to liquidity management by the mutual fund managers themselves (Morris, Shim, and Shin, 2017). When faced with redemption pressures from investors, bond funds tend to sell more of the underlying asset so as to build up cash buffers for precautionary reasons. Hence, studies that focus only on investor redemptions tend to underestimate the sales of the underlying assets by the mutual funds themselves. In contrast, our dataset gives a direct measurement of the portfolio holdings of the respective investor sectors that "sees through" the liquidity management operations of the fund managers, thereby facilitating the broader macro assessment.

The two advantages of our dataset listed above are especially pertinent in the light of the renewed scrutiny of the role of open-ended bond funds in the propagation of financial stress during the early weeks of the COVID-19 crisis in March 2020 (see, for instance, Falato, Goldstein, and Hortacsu, 2021; Schrimpf, Shim, and Shin, 2021; Vissing-Jorgensen, 2021). Stresses were seen over a wide range of asset classes, including corporate bonds, Treasury markets, and EME sovereign bonds' portfolio outflows amounted to more than $100 billion in March 2020 (IMF, 2020).

Thanks to our comprehensive data that disentangle the currency denomination from underlying returns in domestic currency, we can address Original Sin Redux (Carstens and Shin, 2019). In addition to the currency dimension, our data at the annual frequency allows us to analyze the behavior of the same investor type within the same country depending on the maturity (short or long) of its holdings. Our analysis will then be able to address the double-edged nature of long-term borrowing, and how duration risk lies at the heart of the market stress dynamics of emerging market sovereign bonds.

Our sample of 16 countries consists of middle income EMEs that have made progress in their ability to borrow abroad in their own currency: Brazil, Chile, Colombia, Hungary, Indonesia, South Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Singapore, South Africa, Thailand, and Turkey. We chose these countries based on the availability of flows data and local currency interest rates.

US investors play a prominent role among the non-resident investors. Figures 13 and 14 presented in the Appendix show the annual outstanding value of holdings from TIC data by US investors, and their net purchases (sales) of government bonds (USD million) for our sample of 16 EMEs, for dollar-denominated bonds and in local currency.[1] US investor holdings are primarily in local currency bonds in Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa and Thailand, whereas US investor holdings are mostly denominated in US dollar in Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia and Turkey. In the case of Malaysia, Singapore, and Thailand, US investors hold essentially only government bonds denominated in local currency. The magnitude of the outstanding value of US holdings in local currency is also important, and it peaked at 38 USD billion in Brazil, 28 USD billion in Mexico, and 18 USD billion in Korea and Poland.

2.1 A look at the investor data

The top panel of Figure 2 shows the outstanding market value (in USD billion) of local and USD currency government bonds by type of US investor since 2004. The investor types are: mutual funds, pension funds, insurance companies, and other investors which comprise depository institutions, non-financial investors, other funds, and other financials. In this classification, "other funds" denote collective investment vehicles that fall outside the regulated mutual funds sector, notably, hedge funds and other funds that trade on their own account. "Non-financials" include non-financial corporations as well as endowments and trusts. The group "other financials" includes financial institutions that are not captured elsewhere, most notably the broker-dealer sector.

[1] US investors additionally held a small number of bonds denominated in other currencies such as the euro and the yen, but these holdings account for less than 2 percent of their total holdings of sovereign bonds in these countries.

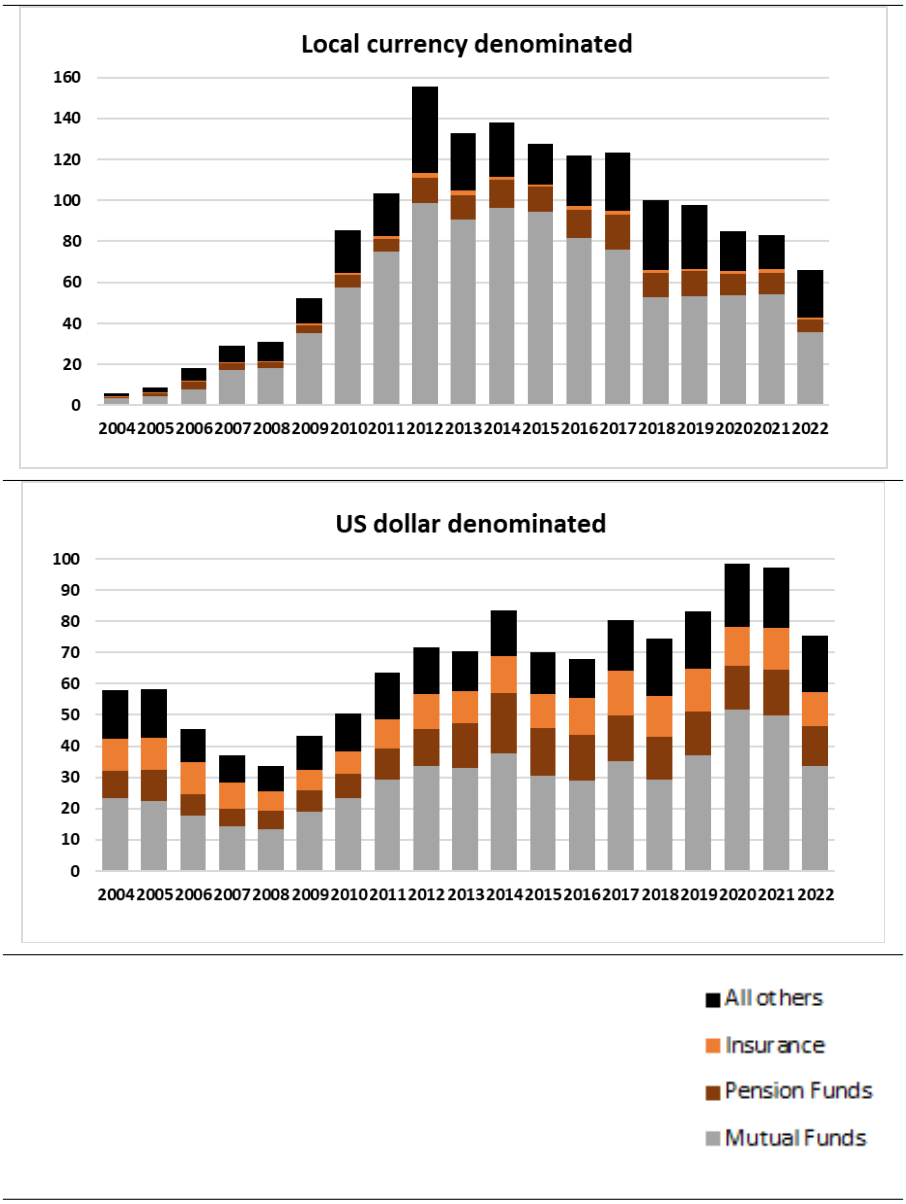


Figure 2: **Local currency and US dollar bond holdings by investor type.** This figure shows the holdings (USD billion) of government bonds that are denominated in local currency or US dollar for our sample of sixteen EMEs by type of investor: Mutual Funds, Pension Funds, Insurance, and All Others. All Others comprises Other Funds, Depository Institutions, Other Financial Institutions, and Non-financial institutions.

For each of these seven sectors, we know the year-end market value of government bond holdings of each issuer by currency of denomination since 2014. For the period before 2014, the information in our dataset depends on the sector. For three of these sectors (mutual funds, pension funds, insurance companies) we have information on the year-end holdings of government bonds of each issuer by currency of denomination since 2004. For the other sectors (depository institutions, non-financial institutions, other financial institutions, and other funds) we know their holdings in aggregate during the period 2004-2013.[2]

Mutual funds stand out as the largest holder of these bonds, accounting for about 60% of US resident holdings, averaged across years. For some economies, such as Indonesia and Korea, mutual funds account for almost all of the US investor holdings, while Chile has the lowest investment holding by mutual funds. We also see in these aggregate annual data that the portfolio holdings of mutual funds fluctuate considerably. Part of the fluctuations are due to valuation effects due the fluctuations in the exchange rate, which the empirical analysis controls for by looking at actual purchases and sales. Mutual fund portfolio values as a proportion of total US holdings has the largest standard deviation across all US investor sectors (19%).

Pension funds are the second largest sector in terms of market value of holdings, with an average (median) holding figure of 13% (11%), and a standard deviation that is half of that of mutual funds (11%). The insurance sector holds a small share of EME local currency bonds, accounting for 2.5% of US investors. In the aggregate, for all the other sectors (depository institutions, non-financial institutions, other financial institutions, and other funds) the average holdings of local currency sovereign bonds across country-years is about 25% of US resident investors.

The year 2012 is the high water mark of US investor holdings before the period of dollar strength and emerging market stress between 2013 and 2016. The year 2017 saw a small rebound, but the total holdings fell sharply in 2018 and then again in 2020, reaching the same amount as in 2010. The year 2021 saw another small decline in the total holdings. US mutual fund holdings of EME local currency sovereign bonds stood at almost 100 USD

[2]For less than one percent of the market value of EME government bonds in the earlier years, the investor type could not be classified in any group. We include these "Unknown" holdings in the category “All others."

billion in 2014, but fell to about 50 USD billion by 2018.

Figure 2 (lower panel) shows the analogous information, but for dollar-denominated bonds. Mutual funds again stand out as the largest holders of EME dollar-denominated government bonds, although their share is lower than for local currency bonds. The average and median shares of dollar holdings are 42%. Also notable is how their holdings rise and fall more moderately over the sample, although with a sharp increase in 2020 and decrease in 2022.

The insurance sector and pension funds sector figure prominently as holders of US dollar denominated bonds, with average shares of 20% and 15%, respectively. These sizeable shares are in contrast to their limited holdings of local currency bonds, especially in the case of the insurance sector. Also notable are how stable the holdings are over time for insurance and pension fund sectors. All these features likely reflect the investment objectives of insurers and pension funds. For insurers in particular, their liabilities present bond-like cash flows to policy holders which are met by assets with equivalent duration properties for asset-liability risk management.

Importantly, since US insurers' liabilities are predominantly in dollars, it would be natural for insurers to hold dollar-denominated securities so as to avoid currency risk. The stability of insurer holdings result in the relatively more "sticky" nature of their EME bond holdings.

Finally, comparing US mutual funds holdings across local and USD denominated currency, we see that as US mutual funds investors progressively decrease their holdings in local currency after 2014, instead they slowly by steadily increase their holdings denominated in US dollar, with a notable increase in 2020 post-Covid shock. In 2020, the holdings in local and dollar currency by US mutual funds are approximately the same, after years when the holdings in local currency have been up to three times those denominated in US dollar. All in all, while this sample of EME governments has been able to overcome Original Sin by borrowing from global investors in domestic currency, we observe a decreasing trend in local currency holdings by global investors after 2012.

Figure 2 groups depository institutions, non-financial institutions, other financial institutions, and other funds under one category (All others) due to data availability. For each of

these four sectors, we know the year-end holdings of government bonds of each issuer by currency of denomination starting in 2014 (see Figure 15 in the Appendix). For local currency bonds, within the category "All others", the depository institutions have the smallest share, with an average of 3% with respect to all the US investors. The sector "Other financials" accounts on average for 6% of the total EME local currency bonds held by US investors. "Non-financial institutions" hold on average 7% of the total US investments in EME local currency bonds, while "Other funds" account on average for 7% of the total US investments.

3 Investor type analysis

The focus is on how investor bond flows fluctuate with shifts in the dollar exchange rate. We first explore the effect from dollar appreciation on the aggregate flows, and subsequently decompose them into mutual funds' flow response and other US sectors' flows. Different types of investors may be associated with heterogenous propensity for financial procyclicality (see, for instance, Fang, Hardy, and Lewis (2022) and Zhou (2024)). We sequentially look at the sensitivity of (1) aggregate flows, (2) within investor-level flows, and (3) across investor-level flows.

We start with the following specification**:**

$$\Delta B_{c,t,d} = \alpha + \beta \Delta USDBroad_t + \eta_c + \varepsilon_{c,t,d} \tag{1}$$

where $B_{c,t,d}$ is the sum of the notional value of all sovereign bonds of country c at time t which are denominated (d) either in local or USD currency and which are held by US investors, thus $\Delta B_{c,t,d} = \frac{B_{c,t,d} - B_{c,t-1,d}}{B_{c,t-1,d}}$ measures the aggregate US investor bond flows in country c between $t-1$ and t. $\Delta USDBroad$ is the percentage change in the broad US dollar index, and η_c are country fixed effects. The coefficient β captures the *aggregate* US investor flows' response to US dollar appreciations or depreciations.

We use the broad US dollar index as an indicator capturing global financial conditions. The broad US dollar index is taken from BIS statistics and comprises sixty economies. The strength of the US dollar has attributes of a barometer of risk appetite, whereby fluctuations in financial conditions arise from shifts in the risk appetite of global investors. When the

dollar appreciates, financial conditions tighten (Bruno and Shin, 2015a). Under a portfolio approach, a broad based appreciation or depreciation of the dollar affects the global portfolio return of a dollar-based investor beyond each specific country exchange rate fluctuations.

While existing studies address the direct effects of US monetary policy or other shocks, our focus is on the *amplification* effects due to duration risk and its interaction with exchange rate fluctuations. In particular, we make full use of our detailed dataset to explore the importance of duration and currency risk, beyond the traditional vulnerabilities of currency mismatch or maturity mismatch.

We then delve deeper into the different US investor types by running the following specification:

$$\Delta b_{i,c,t,d} = \alpha + \beta_0 \Delta USDBroad_t + \eta_{c,i} + \varepsilon_{i,c,t,d} \tag{2}$$

where $\Delta b_{i,c,t,d}$ is annual bond flows of investor i in country c and denominated (d) in local currency or US dollar, for the period 2004-2022, and $\eta_{c,i}$ are country*investor fixed effects. The coefficient β_0 captures the US investor flows' response *on average* to US dollar appreciation or depreciation.

As we explained in Section 2, investor-level flows $\Delta b_{i,c,t,d}$ are computed as the change in notional holdings of investor i in country c and denominated in currency d between t and $t-1$, scaled by the overall size of the holdings B at $t-1$. Essentially, b measures the magnitude of the investment flows (scaled by the size of the holdings) and allows for a decomposition of the effect coming from the various US investors.[3] Changes in notional holdings (i.e., flows) control for valuation effects due to changes in yields and exchange rates, and are constructed directly from the underlying security-level data on US investor holdings, which allow to measure directly the shifts in the underlying portfolios rather than having to infer the portfolio adjustments indirectly from the fund redemption flows. Thus, our data flows are a better reflection of the underlying portfolio adjustment decisions.

[3]Results are robust to computing investor-level bond flows as the percentage change of b between t and $t-1$. The interpretation of the coefficient estimates is however different: the percentage change captures the direction of investment flows, whereas b scaled by the size of the holding B captures both the direction and the magnitude of the flow.

Lastly, we analyze the heterogenous response by the different US investor types by running the following specification:

$$\begin{aligned}\Delta b_{i,c,t,d} &= \alpha + \beta_0 \Delta USDBroad_t + \beta_1 \Delta USDBroad_t \cdot Pension + \\ &+ \beta_2 \Delta USDBroad_t \cdot Insur + \beta_3 \Delta USDBroad_t \cdot Allother + \eta_{c,i} + \varepsilon_{i,c,t,d}\end{aligned} \tag{3}$$

Here we disentangle the investor-type effect of the broad US dollar index on flows by interacting $\Delta USDBroad$ with dummy variables equal to one (zero otherwise) for each US investor type: $Pension$ is equal to 1 for pension fund investors, $Insur$ is equal to 1 for the insurance sector, and *Allother* is equal to 1 for all other investors. Thus the solo coefficient β_0 captures the dollar-flows association for the mutual fund investors (i.e., the omitted category), while $\Delta USDBroad$ interacted with the various dummies captures the incremental effect of dollar appreciation on pension funds (β_1), insurers (β_2), or all other investors (β_3) flows relative to the omitted variable (i.e., the mutual funds).

Specifications (2) and (3) include country-investor type fixed effects and Driscoll-Kraay standard errors. Some variations also include country-level control variables. Because we cannot not include year fixed effects or otherwise $\Delta USD\ Broad$ would drop out due to collinearity, we also run a slightly different specification with both country-investor type $\eta_{c,i}$ and year κ_t fixed effects:

$$\Delta b_{i,c,t,d} = \alpha + \beta_0 \Delta USDBroad_t + \beta_1 \Delta USDBroad_t \cdot Mutual + \eta_{c,i} + \kappa_t + \varepsilon_{i,c,t,d} \tag{4}$$

where the dummy variable *Mutual* is equal to one for the mutual funds sector, and zero otherwise. The reference group consists of all the other investor types (pension funds, insurance sector, and all others). The coefficient β_0 will get dropped when the year fixed effects are included. In all specifications, outliers are excluded. In section 6 we present a complementary analysis using a panel VAR with monthly data to inform a causal interpretation of the results.

Table 1: **Summary statistics.** This table shows summary statistics for the sample of sixteen EMEs. Aggregate country flows are annual flows at the country level by all US investors. Investor flows are annual flows of each investor type in each country, scaled by the size of the holdings. Extreme outliers are excluded. The sample period is 2004-2022.

Variable	Obs.	Mean	Std.Dev.	Median	p25	p75
Broad US dollar index %	19	0.9	5.6	2.3	-4.3	4.7
Country aggregate flows						
Aggregate flows (all currencies, %)	280	23.3	51.8	12.8	-10.8	40.6
Aggregate flows (local currency, %)	270	36.4	79.4	16	-10.4	55.4
Aggregate flows (USD currency, %)	254	12.2	51.4	2.5	-10.4	21.6
Investor flows in local currency						
All Investor flows	1047	7.6	23.3	0.8	-1.4	7.8
Mutual funds Investor flows	256	17.9	36.4	8.2	-6.7	32.7
Pension funds Investor flows	263	3.9	14.5	1.5	-1.4	4.7
Insurance sector Investor flows	261	0.9	7.1	<0.1	-0.5	0.9
All other Investor flows	267	7.8	20.9	2.1	-2.7	10.7
Investor flows in USD currency						
All Investor flows	1012	2.7	14.8	0.6	-3.3	5.4
Mutual funds Investor flows	253	5.5	23.4	1.1	-4.7	10.5
Pension funds Investor flows	252	1.7	7.6	0.5	-2.6	4.3
Insurance sector Investor flows	253	0.7	9.1	0.2	-2.7	3.8
All other Investor flows	254	2.7	13.4	0.9	-3.7	5.7

Table 2: **Aggregate Flows.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds held by US investors in any currency (column 1), denominated in local currency (column 2), or denominated in US dollar (column 3), and with Driscoll-Kraay standard errors. USD Broad is the annual percentage change in the Broad US dollar index. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)
Flows	Total	Total	Total
Currency	Any	Local	USD
ΔUSD Broad	-0.9601**	-2.4648**	-0.7658
	[0.4069]	[1.1137]	[0.8065]
Constant	0.2446***	0.3946**	0.1294**
	[0.0695]	[0.1392]	[0.0480]
Obs.	280	270	254

3.1 Evidence on aggregate flows

We start by looking at aggregate flows denominated in any currency (d = domestic and USD denominated) to compute the sensitivity of flows to dollar fluctuations (specification 1). The β coefficient gives an aggregate figure of how US investors in the aggregate respond to dollar fluctuations. Column 1 of Table 2 shows that when the dollar appreciates by 1%, US investor flows decrease by about 1% in the aggregate.

Column 2 shows that such a negative relationship is driven by flows in domestic currency bonds: the β coefficient estimated is -2.46 and statistically significant at the 5% level, meaning that a 1% dollar appreciation is associated with overall large outflows of sovereign bonds denominated in local currency. This negative relationship between dollar appreciation and bond outflows disappears when we look at USD denominated bonds (column 3).

3.2 Evidence on investor flows

Next, we perform the analysis at the investor-level. In Table 3 we start by looking at bond flows denominated in the local currency of the borrower (columns 1 to 5). Column 1 reports the results from specification (2) when including all US investors in the sample. We note that the β_0 coefficient of $\Delta \mathit{USD\ Broad}$ is negative and statistically significant, indicating

that, on average, investor flows respond to shifts in the broad dollar index with statistical significance at the annual frequency.

In column 2, when we restrict the sample to mutual funds only, we observe a strong relationship between a stronger dollar and a contraction in investor flows. The coefficient estimate of Δ *USD Broad* is negative and statistically significant at the 5% level. Specifically, a one percent appreciation in the broad dollar index is associated with a 1.3% decrease in mutual funds flows. The average flow by mutual funds is approximately 18% of the overall size of the holdings. To put this result in perspective, the broad US dollar appreciated on average by 0.9% over the period 2004-2022, with a standard deviation of 5.6%. The dollar depreciated on average by 1.3% until 2011, and then it experienced a prolonged period of appreciation with a 2.5% annual average and peaks of 8% in 2014 and 10% in 2015, consistent with the notable decline in mutual fund holdings of local currency bonds since their high in 2012 as observed in Figure 2.

In Column 3, we confirm that this negative relationship is specific to the mutual fund sector and does not hold for non-mutual fund sectors. The coefficient estimate of Δ *USD Broad* related to the sample of non-mutual fund sample is not statistically significant, suggesting that other investors types, on average, do not have an economically large impact on flows in response to changes in the dollar.

To investigate further, we examine each US investor type by interacting $\Delta USDBroad$ with investor-specific dummy variables. Each dummy variable equals 1 for a given investor type and 0 otherwise, with mutual funds as the reference category (specification 3). Thus, the interaction coefficients capture the difference of each sector from the mutual fund sector. Burger et al. (2015) argue that local factors, such as faster economic growth, more positive current account balances and more stable inflation, may also matter as specific pull factors. For this reason, we include country-level regressors such as GDP growth, inflation volatility (calculated as a 12 months standard deviation of monthly rates of inflation), and current account deficit.

Column 4 shows the results of this panel analysis. The coefficient β_0 for Δ *USD Broad* for the mutual fund sector remains negative and statistically significant. In contrast, the

coefficients $\beta_1$and β_2 for pension funds and insurers are positive and significant, indicating that these investors are approximately 1 percentage point less sensitive than mutual funds. The coefficient estimate β_3 of the variable *All Others* is not statistically significant.[4]

When we look at the aggregate effects for the non-mutual fund sectors (computed as the sum of β_0 and the respective interaction terms β_1, β_2,and β_3), none of the sums are statistically significant. Hence, while pension funds and insurers partially offset mutual fund outflows, they do not fully neutralize them.

A key reason for this outcome is the relative size of each sector. As shown in Figure 2, the mutual fund sector is significantly larger than pension funds and insurers in the local currency bond market. Even though pension funds and insurers counteract the mutual fund sector, their smaller market share means their offsetting effects are insufficient to counterbalance the dominant negative response of mutual funds. As a result, the aggregate effect remains negative.

In columns 1 to 4 we could not include year fixed effects because Δ*USD Broad* would drop out due to collinearity. Hence, in column 5, we run a slightly different specification (specification 4). Specifically, we use the dummy variable *Mutual* that is equal to one for the mutual funds sector, and zero otherwise, interacted with Δ*USD Broad*. The reference group consists of all the other investor types (pension funds, insurance sector, and all others aggregated). This allows us to run a specification that includes both country-investor type and year fixed effects. Column 5 shows that the coefficient of the interaction term *Mutual**Δ*USD Broad* is negative and statistically significant, consistent with the previous evidence demonstrating the strong procyclical behavior of mutual funds to dollar fluctuations.[5]

In Table 9 in the Appendix we perform a battery of other checks. First, we replicate the analysis by using the broad US dollar vis-à-vis advanced economies to alleviate endogeneity between the dollar exchange rate and investment flows in EMEs. We then show that the broad

[4]When we run the specification for the shorter available time period and disaggregating All Others into depository institutions, non-financial entities, other funds and other financial, none of the four investor types stand out as driving the positive coefficient, likely due to a large heterogeneity within countries (results not shown).

[5]In untabulated specifications, we also attempt to use country-year fixed effects, however in a few instances the fixed effects saturation produces a highly singular variance matrix.

US dollar index does indeed have a greater impact than the individual country exchange rate dynamics, which suggests that a global factor is at play, namely global investors responding to risk-off and risk-on periods (consistent with Hofmann, Shim and Shin, 2022). We also look at the VIX and US monetary policy as alternative global factors. Finally, we show that the procyclical behavior of mutual funds is accentuated in countries with greater financial openness.

Next, in columns 6 to 8 of Table 3 we consider flows of USD denominated bonds as our dependent variable, and we run specifications (2) and (3), but with flows of dollar-denominated bonds. Column 6 shows that on average dollar appreciation is not associated with investment outflows. When we look at the mutual fund sector, we see that the coefficient β_0 related to the mutual fund sector is negative but not statistically significant (-0.43) (column 7).

When examining other investor types (column 8), we see that the coefficient β_1 related to the pension funds sector is positive and statistically significant ($+0.62$) as in the case of local currency bonds. This suggests that for dollar-denominated bonds, pension funds play a buffering role to sales. When we look at the aggregated effects (estimated by the sum of β_0 and the respective interaction terms β_1, β_2, and β_3), they are not statistically significant at the annual frequency.[6] For pension funds, the economic magnitude of the impact is important because their holdings of USD denominated bonds are large (Figure 2) so their purchases offset any negative outflow by mutual funds, though not enough to make a positive impact on the aggregate.

Given the stickier nature of pension liabilities, the premium is likely to be less volatile in the dollar-denominated segment of the market, consistently with the evidence in Timmer (2018). The "buffering" role played by pension funds is consistent with the evidence found in Ng, Shim, and Vidal Pastor (2019) who show that, during the Taper Tantrum, mutual

[6] In untabulated regressions we investigate an alternative definition of the flow variable. Rather than scaling the investor-level change in notional holdings by the size of the holding, we compute the annual percentage change of bond flows for each investor type. The coefficient estimates now capture the direction of the flows, but they do not account for the overall magnitude of the holdings. We find that the signs of coefficient estimates remain the same (negative for mutual funds and positive for pension funds), and now both are statistically significant. Taken together, we interpret this result as evidence that when the dollar appreciates mutual funds sell and pension funds buy.

Table 3: **Investor Flows.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds held by each US investor type, and with Driscoll-Kraay standard errors. Investor types are: mutual funds, pension funds, insurance, and others. USD Broad is the annual percentage change in the Broad US dollar index. In columns 1 to 5 the bond flows are denominated in the local currency of the borrower, in columns 6 to 8 bond flows are denominated in US dollar. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Currency			Local				USD	
Sector	All	Mutual	Non-Mutual	All	All	All	Mutual	All
ΔUSD Broad	-0.4794**	-1.3008**	-0.2126	-1.3259**		-0.1532	-0.4348	-0.4904
β_0	[0.2117]	[0.5906]	[0.1411]	[0.5210]		[0.1783]	[0.3362]	[0.3025]
β_1 Pension*				1.0180*				0.6201*
ΔUSD Broad				[0.5378]				[0.3162]
β_2 Insur*				1.0800**				0.3555
ΔUSD Broad				[0.4740]				[0.2911]
β_3 All Others*				1.1423				0.1588
ΔUSD Broad				[0.6608]				[0.2243]
Mutual*					-1.0794*			
ΔUSD Broad					[0.5438]			
GDP Growth				1.1180***				-0.2929*
				[0.2478]				[0.1645]
Inflation Vol				0.0325				0.0311
				[0.0389]				[0.0306]
Current Acc				0.4738**				-0.6235**
				[0.2154]				[0.2296]
Constant	0.0824***	0.1975***	0.0451***	0.0269	0.2329***	0.0287***	0.0605***	0.0256*
	[0.0265]	[0.0651]	[0.0153]	[0.0261]	[0.0082]	[0.0097]	[0.0169]	[0.0123]
Ctry-Inv FE	✓	country	✓	✓	✓	✓	country	✓
Year FE					✓			
Obs.	1,047	256	791	1,044	1,047	1,012	253	1,008

funds were subject to outflow pressures and liquidated their bond holdings of emerging Asian bonds, while insurance companies, annuities and pension funds bought additional bonds in these markets. This finding highlights possible clientele effect of particular investor sectors. Insurers have bond-like liabilities to policy holders, and their investment strategies are geared toward holding similar duration assets as a hedge against duration risk.

Taken together, the message is that the local currency-denominated flows display a strong sensitivity to dollar fluctuations, adding weight to the risk-taking channel discussed in Bruno and Shin (2015a, 2015b) and to the role of the broad dollar index as a barometer of risk appetite. Our findings are suggestive of a global portfolio adjustment effect by US mutual funds. When financial conditions change (as measured by the broad dollar index), then mutual funds appear to retreat from local currency denominated EME bonds. So, the mutual fund sector (the largest holders of emerging market sovereign bonds) stands out as the investor sector that is most sensitive to dollar fluctuations.

3.3 Duration Risk

Table 3 has highlighted the distinct procyclical behavior by mutual funds and especially for local currency bonds. In this section we delve deeper into the mutual fund sector with a focus on the maturity of their holdings. EME issuers have been able to satisfy investors' search for yield by issuing longer maturity bonds, especially after the 2007-8 financial crisis. Longer maturities mitigate rollover risk for the borrower, but at the cost of subjecting investors to greater duration risk.

Figure 3 shows the average maturity at issuance (in years) and the average remaining maturity of bonds denominated in US dollars or in local currency for our sample of countries. Two observations stand out. First, US investors hold longer maturity dollar-denominated bonds than local currency bonds. Second, over time, borrowers have been able to issue bonds at longer maturities, with an especially noticeable increase for local-currency bonds. Specifically, the average maturity at issuance of local currency bonds jumped from 9 years in 2003, to 15 years in 2022. There is a considerable variability by country, even among countries where holdings are primarily in dollars. Overall, 25 percent of dollar-denominated bonds held

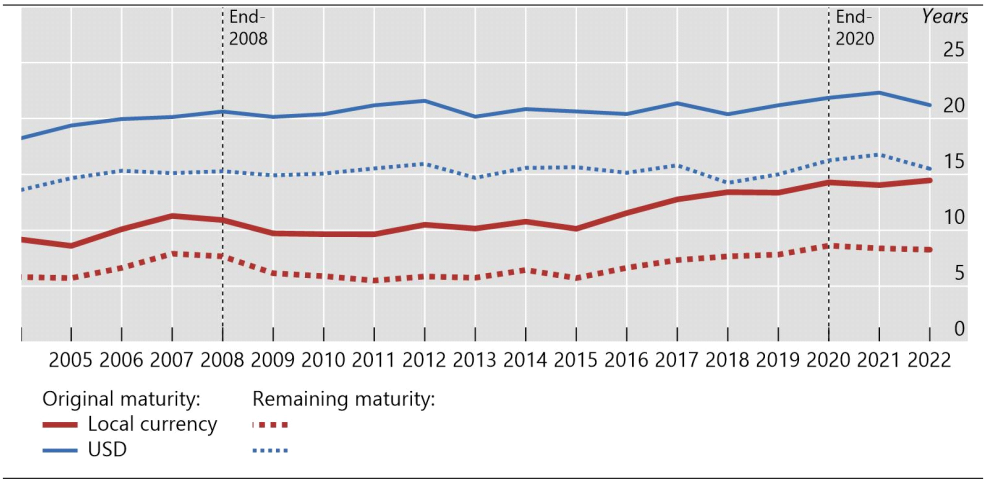


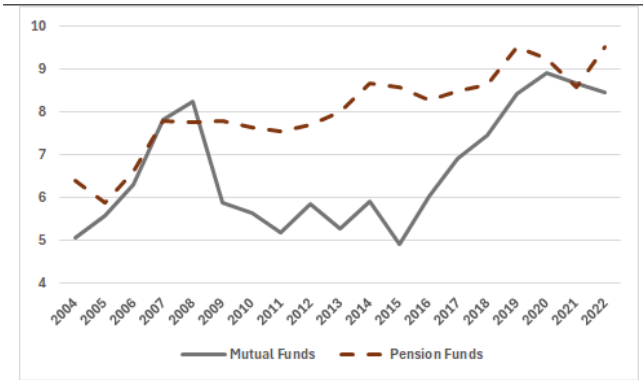
Figure 3: **Maturity of local and US dollar denominated bond holdings.** This figure shows the mean value of maturity at issuance (solid lines) and the mean value of the remaining maturity (dash lines) of government bonds denominated in US dollar (blue color) or in local currency (red color) for our sample of sixteen EMEs over the period 2003-2022.

by US investors have a remaining maturity of over 23 years. Remaining bond maturity is notably shorter for local currency denominated bonds, where the median remaining maturity is 5 years.

In Figure 4, Panel A, we zoom into the investor sector of the local currency denominated bonds. From Figure 2 we know that mutual funds and pension funds are the two investor types with the largest holdings of local currency bonds. Panel A of Figure 4 reports the average remaining maturity of mutual funds (in grey) and pension funds (in maroon) holdings across all 16 countries in our sample. We see that mutual funds have been holding local currency bonds with remaining maturities of about 5 to 6 years between the period from 2009 to 2015, after which we see an uptick in bond maturities, peaking to 9 years in 2020. The increasing trend in the maturity of the holdings by mutual funds is common across countries, e.g., in Malaysia, Mexico, and Korea - three countries where US investor holdings of local currency bonds are the largest. In particular, in Malaysia and Mexico mutual funds hold local currency bonds with remaining maturities significantly longer than pension funds do.

Panel B of Figure 4 shows the investor sector decomposition of the US dollar denominated

Panel A
Local currency denominated bonds



Panel B
USD denominated bonds

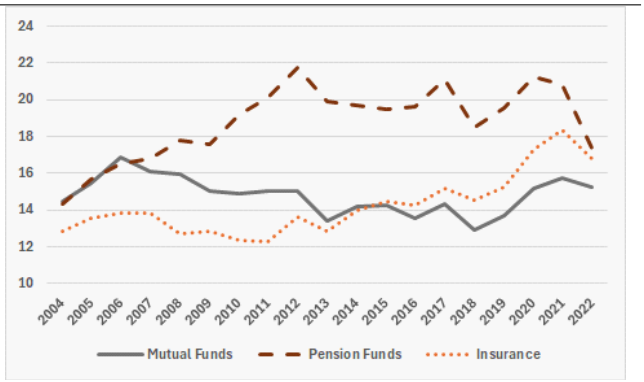


Figure 4: **Remaining maturity of local and USD denominated holdings by investor type.** Panel A of this figure shows the mean value of the remaining maturity of government bonds denominated in local currency held by mutual fund investors (grey line) and by pension fund investors (maroon line) for our aggregated sample of sixteen EMEs. Panel B shows the mean value of the remaining maturity of government bonds denominated in USD currency held by mutual fund investors (grey solid line), by pension fund investors (maroon long-dashed line) and by the insurances (orange dashed line) for our aggregated sample of sixteen EMEs. The period is 2003-2022.

bonds. From Figure 2 we know that mutual funds, pension funds, and insurance companies are the three investor types with the largest holdings of dollar denominated currency bonds. Panel B reports the average remaining maturity holdings by mutual funds (in grey), by pension funds (in maroon) and by insurance companies (in orange) across all 16 countries in our sample. We see that pension funds hold bonds with the longest maturities. USD holdings by mutual funds have longer maturities than for local currency bonds, ranging on average between 13 and 16 years. However, we do not observe a significant increase in the maturities of the USD holdings by mutual funds after 2015. A similar trend occurs is common across countries, especially in countries like Indonesia, Colombia, and Mexico, where US investor holdings of USD denominated currency bonds are the largest.

All in all, Figure 4 shows that mutual funds have significantly increased their exposures to duration risk in local currency denominated bonds over time, reaching a peak in 2020. When mutual funds respond to fluctuations in the dollar exchange rate, do they differentiate according to the maturity of the bonds they hold? To answer this question, we calculate

the annual flows by country-year-currency and according to their remaining maturity, and re-run the analysis in Section 3.2, but for flows split according to their remaining maturity.

Panel A of Table 4 shows the results related to US investor flows denominated in local currency. Columns 1 and 2 show the results from specification (1), where $B_{c,t,d}$ is now split between holdings with longer remaining maturity (greater than 5 years) and shorter remaining maturity (less than 5 years), respectively. We see that the negative association between dollar appreciation and local currency flows is driven by longer maturity bonds.

Columns 3 to 5 decompose the effect of dollar appreciation on flows into mutual funds' flow response and all other US investors' flows (specification 4). $b_{i,c,t,d}$ are split between bond flows with remaining maturity greater than 5 years (columns 3 and 4), and less than 5 years (column 5).

In columns 3 and 4 we see the β_1 coefficient of the interaction $\Delta USDBroad_t \cdot Mutual$ is negative and statistically significant, whereas β_0 is not statistically significant. The magnitude of the mutual fund flows ($\beta_0 + \beta_1$) is large as exemplified by their large holdings of local currency bonds as compared to the holdings by pension funds, insurers and all other investors. Importantly, non-mutual funds investors do not offset the outflows from mutual funds following dollar appreciation. This result illustrates how mutual funds' flow response following dollar appreciation is driven by bonds with longer maturities rather than by bonds with shorter maturities, for which the coefficient β_1 of $\Delta USDBroad_t \cdot Mutual$ is not statistically significant (column 5). All in all, dollar appreciation has as significant negative effect on the aggregate US bond flows, and this relationship is driven by the mutual fund sector flows of longer maturity bonds.

Such a negative relationship between dollar appreciation and bond outflows disappears when we look at USD denominated bonds. Panel B of Table 4 essentially replicates Panel A analysis, but for bonds denominated in USD. Here, none of the coefficients (β, $\beta_0 + \beta_1$) are statistically significant, highlighting that dollar appreciation does not have a significant effect on total external flows by US investors in the case of USD denominated bonds and regardless of the maturity of the bonds.

Taken together, mutual funds' behavior is different from the case of local currency de-

Table 4: **Investor flows: Long-term vs Short-term maturity.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds held by each US investor type, and with Driscoll-Kraay standard errors. USD Broad is the annual percentage change in the Broad US dollar index. Panel A (B) reports results for bonds denominated in local (USD) currency. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

		(1)	(2)	(3)	(4)	(5)
	Flows	Total	Total	Investor	Investor	Investor
	Maturity	Long	Short	Long	Long	Short
	Ctry FE	Y	Y			
	Ctry-Inv Type FE			Y	Y	Y
	Year FE				Y	
	Panel A: Local currency bonds					
β_0	ΔUSD Broad	-4.8306**	-2.6116	-0.2307		-0.2395
		[2.1754]	[2.4239]	[0.2187]		[0.1997]
β_1	Mutual			-1.4286*	-1.4090*	-0.8542
	*ΔUSD Broad			[0.7287]	[0.7056]	[0.9549]
	Constant	0.6528**	0.5815***	0.1137**	0.4202***	0.1032***
		[0.2445]	[0.1902]	[0.0394]	[0.0126]	[0.0348]
	β_0+β_1			-1.6593*		-1.0937
	p-value			0.053		0.314
	Observations	265	260	1,007	1,007	981
	Panel B: USD currency bonds					
β_0	ΔUSD Broad	-0.7596	-0.9577	0.0373		0.0107
		[0.9593]	[0.9298]	[0.1998]		[0.1653]
β_1	Mutual			-0.4847	-0.4981	-0.5695
	*ΔUSD Broad			[0.2876]	[0.2893]	[0.3424]
	Constant	0.1643***	0.1546**	0.0482***	0.1040***	0.0320***
		[0.0272]	[0.0588]	[0.0069]	[0.0048]	[0.0107]
	β_0+β_1			-0.4474		
	p-value			0.316		0.149
	Observations	210	253	844	844	1,012

nominated bonds because their dollar returns are not subject to valuation effects due to exchange rate fluctuations that may be concurrent or amplify yield changes. For this reason, duration risk is more relevant for local currency than for USD-denominated bonds.

4 Strategic Complementarities

Why does duration risk matter more for mutual funds than for other investors? We show that duration risk matters more for mutual funds because the incentive of mutual fund investors to sell increases in the expectation that other investors will do the same. Mutual fund investors have the right to redeem their shares at the net asset value (NAV) at the close of day. Following large outflows, mutual funds may need to adjust their portfolios by selling assets at a cost, which is borne by the remaining investors rather than by the redeeming investors. The results presented in Table 4 suggest that longer duration holdings of local currency bonds are associated with the strongest negative spillovers to remaining investors - at least, as evidenced in the largest bond outflows. In this section we put the strategic complementarity hypothesis to the test and show that it holds for mutual funds holding local currency bonds.

Chen, Goldstein, and Jiang (2010) demonstrate in a global game setting that the negative externality arising from the expectation that other investors will sell reduces the expected returns from holding, raising the relative payoff of joining the sell-off. They find that investors in US equity mutual funds with illiquid assets have a stronger incentive to redeem their shares than those in funds with more liquid assets because they anticipate that redemptions by other funds impose costs. Thus, the decision to hold rather than sell will be exposed to the negative externality of others' redemptions.

In a follow-up paper, Goldstein, Jiang, and Ng (2017) look at US corporate bond mutual funds and find a greater sensitivity of bond outflows to bad performance. Additionally, they find that liquidation costs imposed on funds due to large outflows are expected to be more severe during periods of higher illiquidity, like in presence of high market volatility, when bonds trade even less and trading is more costly. This creates strategic complementarities among corporate-bond-fund investors in their redemption decisions.

Our confidential TIC data is at the bond level and they are reported at the custodial level. This means that we do not observe the name of the fund holding the security, but only the type of the holder – whether it is a mutual fund, pension fund, insurers, or else. Consequently, we cannot run a fund-level analysis by using TIC data. Instead, we run an auxiliary investigation using the Lipper mutual fund database, which contains information on mutual fund holdings, including currency denomination and maturity.

From Lipper, we first selected all EME local currency sovereign bond mutual funds (ETFs excluded). We could find flows and performance information for 54 funds, most of them domiciled in the US, Luxemburg, or Ireland, for the period starting in 2003. For a smaller number of funds (18 funds, all domiciled in the US), we could find information about the maturity of the holdings, which we use to compute the weighted average maturity of the bond fund.

We run the following specifications. First, we start with the larger sample of 54 funds and run the following panel regression at the monthly frequency t, with fund fixed effects and standard errors clustered at the fund level m:

$$F_{m,t} = \alpha + \beta_0 \Delta USDBroad_{t-1} + \varepsilon_{m,t} \tag{5}$$

The net fund flows F are computed following Goldstein, Jiang, and Ng (2017) (standard in the literature) as $F_t = \frac{TNA_t - TNA_{t-1}(1+\text{Ret}_t)}{TNA_{t-1}}$, where TNA is the total net assets managed by the fund and Ret is the return. When market illiquidity is higher, strategic complementarities between mutual fund investors should be stronger and lead to greater sensitivity of outflows. In our setting, we hypothesize that since dollar appreciation is associated with a tightening of financial conditions, β_0 is negative when the dollar appreciates.

We then run a variation of specification (5) by interacting $\Delta USDBroad$ with the weighted average maturity ($Maturity$) of the bond fund m:

$$\begin{aligned} F_{m,t} \quad = \quad & \alpha + \beta_0 \Delta USDBroad_{t-1} + \beta_1 \Delta USDBroad_{t-1} \cdot Maturity_{m,t-1} \\ & + \gamma Maturity_{m,t-1} + \varepsilon_{m,t} \end{aligned} \tag{6}$$

Provided that the yields of longer maturity bonds react more to fund outflows resulting from dollar strength (which we show in the next section 5), we expect that greater duration risk at the level of the fund will generate stronger strategic complementarities among investors in their redemption decisions. This follows from the well-known result in fixed income analysis that the percentage (negative) return on a bond is given by the product of the duration of the bond and the yield change. In other words,

$$\text{Percentage return} = -\text{Duration} \times \Delta\text{yield} \tag{7}$$

As we demonstrate in the next section, yields of longer maturity bonds react more to fund flows resulting from dollar strength. Hence, both components in the product on right-hand side of (7) is larger for longer maturity bonds. Translated to the fund level, when the dollar appreciates, bond funds with longer maturity bonds suffer a larger negative returns due to outflows and hence exhibit stronger strategic complementarities. Hence we expect β_1 to be negative.

Column 1 of Table 5 shows that dollar appreciation leads to bond outflows: when the dollar appreciates by 1%, bond funds suffer average outflows of 1.1%. This result is consistent with the core result in the paper using bond-level information from TIC data. Columns 2 and 3 show that outflows following 1% dollar appreciation are more sensitive to negative performance ($Perf < 0$) (outflows of 1.3%, column 2) than good performance ($Perf > 0$) (outflows of 0.6%, column 3).

Column 4 is our key result. Here, we see that the coefficient β_1 of the interaction term $USD\_Broad * Maturity$ is negative and statistically significant, meaning that outflows are larger for bond funds with longer maturity holdings following dollar appreciation. In terms of magnitudes, a bond fund with average maturity of 7 years will have 0.9% larger outflows than a bond fund with average holding maturity of 4 years for each 1% dollar appreciation. This result applies to the subset of funds with negative performance. Columns 6 and 7 replicate columns 4 and 5 specification by looking at the preceding three months returns ($Perf(3)$) with qualitatively similar results.

Taken together with the results on yield changes in the next section, our findings estab-

Table 5: **Strategic Complementarities.** This table shows panel regressions where the dependent variable is the monthly bond funds flows for a sample of EME local currency sovereign bond mutual funds. USD Broad is the monthly percentage change in the Broad US dollar index. Standard errors are clustered at the fund level. Maturity is the fund weighted average remaining maturity. Perf <0 (>0) indicates that the fund has negative (positive) returns preceding the flows. The sample period is 2003-2024. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	All	Perf <0	Perf >0	Perf <0	Perf >0	Perf (3) <0	Perf (3)>0
$\beta_0\Delta$USD Broad	-1.1590***	-1.3384**	-0.6552**	1.5182	-0.3206	3.3724**	2.0869
	[0.4041]	[0.6046]	[0.2613]	[0.9321]	[1.3769]	[1.3535]	[4.4971]
$\beta_1\Delta$USD Broad				-0.3036*	-0.0586	-0.5407**	-0.2424
*Maturity				[0.1459]	[0.1808]	[0.2339]	[0.6109]
Maturity				0.0043	0.0015	0.0092	-0.0089
				[0.0033]	[0.0064]	[0.0087]	[0.0118]
Constant	0.0186***	0.0155***	0.0218***	-0.0275	0.0097	-0.0824	0.1104
	[0.0007]	[0.0041]	[0.0008]	[0.0252]	[0.0491]	[0.0619]	[0.0879]
Observations	6,755	3,205	3,500	1,196	1,397	249	429
R-squared	0.005	0.004	0.003	0.008	0.004	0.026	0.003
N Funds	54	54	54	18	18	18	18

lish the strategic complementarity of redemptions at the fund level, so that the mutually reinforcing nature of sales holds more potently when a given quantity of sales by one investor impacts the value of holdings of other investors. Higher weighted average maturity of the local currency bond portfolio holdings show that duration risk is particularly potent due to its interaction with currency risk. Since longer duration amplifies the negative spillovers on the remaining investors, fund investors have a greater incentive to join the run. This creates a first-mover advantage in the redemption decision, amplifying the flows out of funds with longer maturity holdings when financial conditions tighten – effectively a double whammy from duration and currency risk.

In Figure 5 we visualize the flow-maturity relationship established from specification (6). Figure 5 presents the average marginal effects of the US broad dollar index on monthly bond fund flows (vertical axis) across different values of fund's remaining maturity (horizontal axis), based on a semi-parametric fixed-effects regression model controlling for individual-fund effects and clustering standard errors at the bond fund level. The graph illustrates

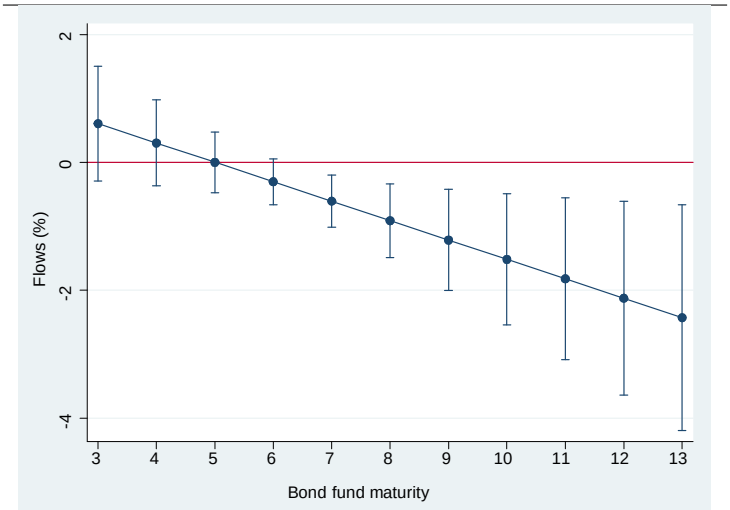


Figure 5: **Flow-US dollar-maturity relationtionship.** This figure presents the average marginal effects of US broad dollar index on monthly bond fund flows across different values of fund remaining maturity and following bond fund negative performance, based on a semi-parametric fixed-effects regression model controlling for individual-fund effects and clustering standard errors at the bond fund level. The sample period is 2003-2024.

how the impact of a one-percent increase in the US broad dollar on bond fund flows as the fund's remaining maturity varies from 3 to 13 years, with 90% confidence intervals. We see that the marginal effect of dollar appreciation on flows increases as bond fund's maturity increases. Specifically, for shorter-maturity bond funds, dollar appreciation has a small or negligible effect on flows. Instead, for longer-maturity bond funds, dollar appreciation has a stronger negative effect and flows decrease more sharply. This aligns with theories of strategic complementarities in investment decisions as in Goldstein, Jiang, and Ng (2017).

Taken together, these results highlight our key message on potential vulnerability for EMEs deriving from exchange rate fluctuations. Longer maturities mitigate rollover risk for borrowers, but this is achieved at the expense of greater sensitivity of bond prices to the greater duration risk for the investor. Specifically, mutual funds flows are the most sensitive to exchange rate fluctuations and show the greatest redemption that generates larger outflows of local currency bonds following dollar appreciation because of the higher degree of strategic complementarities. To the extent that investor reactions amplify market disruptions, longer maturities may introduce new vulnerabilities with the potential to affect the availability and

cost of finance, and the way such selling pressures could affect the domestic yield curve even in the case of local currency issuances.

5 Impact on yields

Yields impact financial conditions, with higher yields being associated with tighter financial conditions. We complete the argument on strategic complementarities by examining the impact on yields of shifts in risk appetite as captured in the fluctuations in the broad dollar index. Specifically, we show that longer maturity bonds tend to react with higher yields following dollar appreciation. There are key related questions. Does investor composition matter? Is the propensity to amplify dollar fluctuations more accentuated for local or dollar-denominated bonds? We also provide aggregate evidence of who is absorbing the sell-off of local currency bonds by US investors and on the role of the US dollar as a cross-sectional asset pricing factor.

5.1 Yield analysis

We investigate how sovereign bond yields respond to investor flows. We use a similar approach as in Zhou (2024) and we run the following regression:

$$\begin{aligned} \Delta Y_{b,c,t,d} &= \alpha + \beta_0 \Delta USDBroad_t + \beta_i \Delta USDBroad_t \cdot Inv\_share_{i,b,c,t-1,d} + \\ &+ Inv\_share_{i,b,c,t-1,d} + \eta_{b,c,t} + \varepsilon_{i,b,c,t,d} \end{aligned} \tag{8}$$

where $\Delta Y_{b,c,,t,d}$ is the change in the yield of bond b denominated in currency d in country c between year $t-1$ and year t. $Inv\_share_{i,b,c,t-1,d}$ captures how much each investor i holds of bond b as a share of the outstanding amount at $t-1$. The investors i are mutual funds ($Mutual\_sh$), pension funds ($Pension\_sh$), insurers ($Insurance\_sh$), and all others ($Other\_sh$). The coefficients β_i capture how yields are sensitive to the size of US investor's holdings following dollar appreciation. We also include the 10 year US government bond yield,

country GDP growth, and inflation volatility as additional control variables in the spirit of pull/push factors, and $\eta_{b,c,t}$ are bond, country, and year fixed effects. Each individual bond data are from the confidential TIC database, whereas bond outstanding amounts are from Refinitiv.

Table 6 reports the coefficients from specification (8) for local currency bonds. Columns 1 and 2 show evidence for all bonds irrespective of their maturity. We see that a 1% dollar appreciation is associated with a 4 basis points increase in local currency bond yields. Importantly, the interaction term between the dollar and investor share is positive and statistically significant only in the case of mutual funds ($USDBroad * Mutual\_sh$), meaning that as US mutual funds hold a large share of a country bond, the yield of that bond will be more sensitive to exchange rate fluctuations. For instance, US mutual funds that hold 4% of a specific country sovereign bond are associated with an additional 2 basis point increase in bond yield following a 1% dollar appreciation on average per year.

Columns 3 and 4 report our key finding. The coefficient on the interaction term $USDBroad*$ $Mutual\_sh$ is much larger and statistically significant only for the subsample of bonds with remaining maturities greater than 5 years; it becomes insignificant for maturities shorter than 5 years. This finding shows that the yield changes for longer maturity bonds are more pronounced than for shorter maturity bonds for any given appreciation of the US dollar. As stated in (7), the percentage return is the product of the (negative of the) duration and the yield change. Hence, funds with longer maturity bonds have larger percentage losses for any given dollar appreciation, generating greater strategic complementarities.

Results are robust to the inclusion of bond fixed effects (within bond variation), country fixed effects (within country variation) and year fixed effects (time-varying unobserved characteristics). As in Section 3, we do not include country-time fixed effects because of multicollinearity as holdings may be concentrated in some countries. In Table 10 of the Appendix, we perform a complementary instrumental variables analysis that examines the response of bond yields to US mutual funds' flows.

Table 7 examines the case of dollar denominated bonds. Dollar appreciation is again associated with an increase in the bond yields, however, differently from the case of lo-

Table 6: **Yield Analysis: Local currency bonds.** This table shows panel regressions where the dependent variable is the annual change in the bond yield denominated in local currency of the borrower. Mutual is the ratio of the local currency-denominated bond holdings by US mutual funds divided by the bond outstanding amount as of the previous year. Similarly, Pension, Insurance, and Other, are the corresponding ratios for pension funds, insurance companies, and other investors (depository institutions, non-financial investors, other funds, other financials). USD Broad is the annual percentage change in the Broad US dollar index. Columns 1 and 2 report regressions for all bond maturities, columns 3 and 4 for bond remaining maturities greater than five years, and columns 5 and 6 for bond remaining maturities less than five years. Standard errors are clustered at the bond level. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Maturity	All	All	Long	Long	Short	Short
ΔUSD Broad	0.0417***		0.0227**		0.0753***	
	[0.0085]		[0.0089]		[0.0171]	
ΔUSD Broad*Mutual_sh	0.5546***	0.5054***	0.8278***	0.7129***	0.1892	0.2349
	[0.1579]	[0.1475]	[0.1813]	[0.1597]	[0.2812]	[0.2740]
ΔUSD Broad*Pension_sh	-0.7989*	-0.3261	-0.6261	-0.2692	-1.3401**	-0.7236
	[0.4453]	[0.4190]	[0.5455]	[0.4992]	[0.6383]	[0.6007]
ΔUSD Broad*Insurance_sh	2.6915	2.5061	5.1219	4.9195*	1.3125	2.1529
	[1.8351]	[1.7511]	[3.2967]	[2.6431]	[2.0849]	[2.1613]
ΔUSD Broad*Other_sh	0.3346	0.3552	0.3175	0.2425	0.1055	0.2982
	[0.3106]	[0.2804]	[0.3761]	[0.3163]	[0.4142]	[0.3754]
Mutual_sh	-5.3253***	-4.1336***	-5.3288***	-4.2474***	-0.4011	0.3577
	[1.1511]	[1.1348]	[1.2792]	[1.2174]	[1.7699]	[1.7008]
Pension_sh	-10.6604**	-11.4983***	-10.2349	-11.3198*	-19.7721***	-18.8034**
	[4.4321]	[4.1109]	[7.1745]	[6.6285]	[7.3555]	[7.3432]
Insurance_sh	1.9809	0.9420	-7.2178	-13.7912	1.0655	6.4864
	[14.2735]	[13.1610]	[18.7611]	[16.6252]	[23.3074]	[20.5523]
Other_sh	-3.6921	-5.3049**	-0.8631	-3.6972	-3.3110	-6.1082
	[2.3025]	[2.2190]	[3.0984]	[2.8385]	[3.7989]	[3.7085]
10 year US yield	0.2756***		0.3331***		0.2140***	
	[0.0343]		[0.0360]		[0.0637]	
Inflation Volatility	0.3433***	0.3287***	0.2259***	0.2189**	0.3316***	0.3915***
	[0.0625]	[0.0636]	[0.0787]	[0.0865]	[0.1075]	[0.0972]
GDP growth	0.1067***	0.1637***	0.0668***	0.1042***	0.1717***	0.2731***
	[0.0095]	[0.0170]	[0.0094]	[0.0140]	[0.0189]	[0.0366]
Constant	-0.5728***	-0.6952***	-0.2959***	-0.3442***	-0.9928***	-1.3180***
	[0.0808]	[0.1015]	[0.0870]	[0.1021]	[0.1487]	[0.1910]
Bond FE	Y	Y	Y	Y	Y	Y
Country, Year FE		Y		Y		Y
Observations	4,257	4,257	2,287	2,287	1,861	1,861
R-squared	0.308	0.373	0.311	0.399	0.381	0.457

cal currency bonds, we do not observe an amplification effect coming from mutual funds ($USDBroad * Mutual\_sh$ is statistically insignificant) or other investors, regardless of long and short maturity bonds.

5.2 Original Sin versus Original Sin Redux

The evidence on yields in the previous section shows that outflows following dollar appreciation are associated with EME fragility through the increase of borrowing costs in domestic currency. Mutual funds play a central role as they show a heightened procyclical behavior. This brings a new channel of transmission of global financial conditions to the domestic economy, even when the borrower has overcome Original Sin. In this section we compare the magnitude of the "traditional" Original Sin channel with its "redux" form by running a simplified version of specification (8):

$$\begin{aligned} \Delta Y_{b,c,t,d} &= \alpha + \beta_0 \Delta USDBroad_t + \beta_1 \Delta USDBroad_t \cdot Dummy\_LC_{b,c,d} + \\ &\quad + \gamma Dummy\_LC_{b,c,d} + \eta_{b,c} + \varepsilon_{b,c,t,d} \end{aligned} \tag{9}$$

where $\Delta Y_{b,c,,t,d}$ is the change in the yield of bond b denominated in currency d in country c between year $t-1$ and year t, and $\eta_{b,c}$ are bond and country fixed effects. $Dummy\_LC_{b,c,d}$ is a dummy equal to 1 if the bond issued by country c is denominated in local currency, and 0 if it is denominated in USD. The coefficient β_0 captures the sensitivity of bond yields denominated in USD to dollar fluctuations. The coefficient β_1 captures the incremental yield effect if the bond is denominated in local currency.

The goal of the analysis is to compare the two channels of fragility. When the traditional original channel is at play, we should observe an increase in the bond yields denominated in USD as the cost of servicing foreign currency debt increases following dollar appreciation. The Original Sin Redux brings in a new channel of fragility to emerging markets as bond yields denominated in local currency are sensitive to dollar fluctuations and foreign investors'

Table 7: **Yield Analysis: USD denominated bonds.** This table shows panel regressions where the dependent variable is the annual change in the bond yield denominated in USD currency. Mutual is the ratio of the USD-denominated bond holdings by US mutual funds divided by the bond outstanding amount as of the previous year. Similarly, Pension, Insurance, and Other, are the corresponding ratios for pension funds, insurance companies, and other investors (depository institutions, non-financial investors, other funds, other financials). USD Broad is the annual percentage change in the Broad US dollar index. Columns 1 and 2 report regressions for all bond maturities, columns 3 and 4 for bond remaining maturities greater than ten years, and columns 5 and 6 for bond remaining maturities less than ten years. Standard errors are clustered at the bond level. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Maturity	All	All	Long	Long	Short	Short
ΔUSD Broad	0.1086***		0.1062***		0.1135***	
	[0.0084]		[0.0120]		[0.0122]	
ΔUSD Broad*Mutual	0.0016	0.0548	0.0031	0.1156	-0.0661	-0.1238
	[0.0920]	[0.0872]	[0.1461]	[0.1564]	[0.1224]	[0.1156]
ΔUSD Broad*Pension	-0.3203*	-0.1965	-0.2083	-0.0901	-0.2616	0.3035
	[0.1669]	[0.1441]	[0.1933]	[0.1603]	[0.3321]	[0.2934]
ΔUSD Broad*Insurance	0.0424	0.1001	0.0386	-0.0022	0.0899	0.1878
	[0.1088]	[0.0989]	[0.1432]	[0.1102]	[0.1726]	[0.1543]
ΔUSD Broad*Other	-0.1955	-0.1199	-0.2650	-0.2142	-0.2340	-0.2423
	[0.1785]	[0.1491]	[0.2345]	[0.1857]	[0.2394]	[0.2013]
Mutual_sh	-1.2724**	-1.3041**	-1.2781	-1.8038*	-0.8338	-0.5531
	[0.6372]	[0.5598]	[0.9431]	[0.9391]	[0.8649]	[0.6858]
Pension_sh	-5.2113***	1.5535*	-5.0617***	1.9163**	-5.0921***	0.4931
	[0.8762]	[0.8353]	[1.1561]	[0.8074]	[1.5297]	[1.4412]
Insurance_sh	4.7995***	1.2857	6.1300***	1.4713	3.4688**	0.4694
	[1.0691]	[0.8089]	[1.4689]	[1.0725]	[1.6697]	[1.3000]
Other_sh	1.4319	0.0977	-0.6657	-2.8667**	2.6481*	1.6279
	[1.0290]	[0.8410]	[1.5977]	[1.1201]	[1.4082]	[1.1850]
10 year US yield	0.4087***		0.4051***		0.4076***	
	[0.0282]		[0.0338]		[0.0440]	
Inflation Volatility	-0.0297*	-0.0963***	0.0109	-0.0113	-0.0629**	-0.1733***
	[0.0166]	[0.0151]	[0.0190]	[0.0168]	[0.0251]	[0.0223]
GDP growth	0.0759***	0.0350***	0.0409***	0.0328***	0.1069***	0.0327***
	[0.0068]	[0.0078]	[0.0095]	[0.0120]	[0.0097]	[0.0108]
Constant	-0.4319***	-0.1332**	-0.1831**	-0.0130	-0.6378***	-0.1496
	[0.0636]	[0.0640]	[0.0856]	[0.0916]	[0.0991]	[0.0960]
Bond FE	Y	Y	Y	Y	Y	Y
Country, Year FE		Y		Y		Y
Observations	2,623	2,623	1,009	1,009	1,593	1,593
R-squared	0.443	0.675	0.455	0.769	0.454	0.674

Table 8: **Yield Analysis: Original Sin vs. Original Sin Redux.** This table shows panel regressions where the dependent variable is the annual change in the bond yield. USD Broad is the annual percentage change in the Broad US dollar index. LC dummy is a dummy equal to one if the bond is denominated in local currency and 0 if the bond is denominated in USD. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)
Maturity	All	All	Large mutual fund %	Small mutual fund %
ΔUSD Broad	0.0976***	0.0844***	0.0860***	0.0864***
	[0.0037]	[0.0036]	[0.0042]	[0.0184]
ΔUSD Broad*LC dummy	-0.0184***	-0.0219***	0.0274**	-0.0413*
	[0.0069]	[0.0067]	[0.0114]	[0.0221]
LC dummy	-0.1786	-0.2714		-0.7641*
	[0.6045]	[0.2161]		[0.1748]
10 year US yield		0.3322***	0.5204***	0.1576***
		[0.0233]	[0.0351]	[0.0519]
Inflation Volatility		0.1223***	[0.0066]	0.0118
		[0.0283]	[0.0300]	[0.1223]
GDP growth		0.0907***	0.0670***	0.0812***
		[0.0061]	[0.0086]	[0.0136]
Constant	-0.0949	-0.4503***	-0.5106***	0.1051
	[0.3725]	[0.1392]	[0.0419]	[0.2511]
Observations	7,055	7,055	2,394	1,773
R-squared	0.2310	0.3130	0.4582	0.3377

outflows. Table 8 shows the results of such comparison.

Column 1 shows that a 1% dollar appreciation is associated with almost 10 basis points increase in the USD bond yields, while local currency yields increase by 8 basis points ($\beta_0 + \beta_1 = 0.079$ and statistically significant at the 1% level), a result that is robust to the inclusion of country-level control variables (column 2). Hence, Original Sin has not disappeared, and countries issuing in foreign currency still bear significant negative effects following a broad appreciation of the US dollar.

However, column 3 shows that when mutual funds hold a large percentage of the bond (above the sample mean), the magnitude of the change in yield is larger for local currency bonds than for USD ones: as the dollar appreciates by 1%, local currency yields increase by 11 basis points (8.6 + 2.7) while USD bond yields increase by about 8 basis points, a difference that is large and statistically significant. The opposite happens when the mutual funds presence is small: as the dollar appreciates by 1%, USD bond yields increase by 8 basis

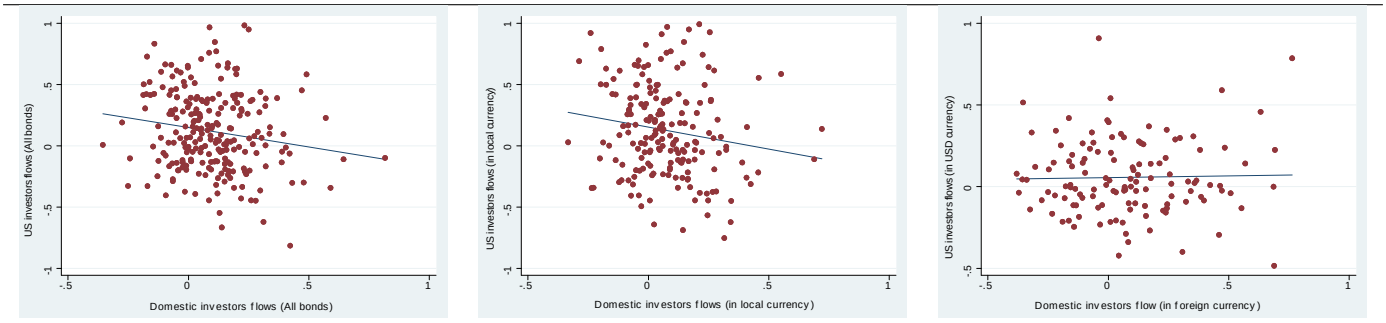


Figure 6: **US Investors versus Domestic Investors.** This figure shows the scatter plot of US investors' bond flows versus the domestic investors's bond flows. The domestic investor data are from Arslanalp and Tsuda, Sovereign Debt Investor Base for Emerging Markets dataset, June 2024 version. Extreme outliers are excluded for graphical exposition.

points while local currency yields increase by about 4 basis points ($8.4 - 4.1$).

The evidence points to the fact that borrowing in domestic currency turns out not to be a panacea: as countries try to escape the fragilities linked to borrowing in foreign currencies, such fragilities come back in a redux form via higher local currency yields following the shift in currency mismatch risks from borrowers to investors. Since the sovereign yield curve underpins domestic financial conditions, the borrowing country ultimately bears the macro risks through tighter domestic financial conditions.

5.3 Who is buying?

The evidence presented thus far shows a distinctive procyclical behavior by mutual funds and a weak offsetting response from other US investors' flows, especially in the case of local currency bonds. In contrast, for USD denominated bonds the actions of mutual funds have a much smaller effect because USD bonds are also importantly held by pension funds and insurance companies that show a less procyclical behavior (Figure 2). Who is absorbing the sell-off of local currency bonds by US investors?

Figure 6 shows the relation between the US investor flows (as captured by our dataset) and domestic investor flows. Domestic flows are computed using the Arslanalp and Tsuda (2014) dataset. The left-hand panel shows the scatter plot of the aggregate US investor bond flows $\Delta B_{c,t,d}$ in any currency (vertical axis) versus the flows of all government bonds that are

held by domestic investors (horizontal axis). This panel shows a negative relationship (the slope of the fitted line is -0.3 with a p-value of 0.01), meaning that domestic investors buy government bonds when US investors sell.

The middle panel of Figure 6 shows the scatter plot of the aggregate US investor bond flows $\Delta B_{c,t,d}$ denominated in local currency (vertical axis) versus the flows of all government bonds that are held by domestic investors (horizontal axis), and reveals that such negative relationship between US and domestic flows is driven by government bonds denominated in local currency: when US investors sell local currency bonds, typically domestic investors pick up the slack from US investors' sales. In contrast, we do not observe such a negative slope in the case of USD denominated bonds, which also reflect the lower procyclicatility of US investors's response to dollar appreciation (right-hand panel, where $\Delta B_{c,t,d}$ denominated in USD is plotted against domestic investor flows).

All in all, the scatter charts suggest that domestic investors (mostly local banks and central banks in periods of distress) absorb some of the sell-off by US investors, especially mutual funds. As studies have shown that other non-US foreign investors sell when the dollar appreciates (e.g., euro area investors as in Boermans and Burger, 2023), this may bring back risk from the lender to the borrower during periods of stress, coupled with the fact that about half of new sovereign debt issuance has ended up on domestic bank balance sheets between 2020 and 2021 (Obstfeld, 2021).

5.4 Dollar betas and Foreign investors presence

One of the core themes in this paper is that the US dollar is a barometer of global financial conditions. When viewed from the perspective of a global investor who evaluates returns in dollar terms, exchange rate movements could amplify their gains and losses, thereby creating an endogenous link between local currency yields and exchange rate fluctuations.

Figure 7, left-hand panel, shows that, in the context of local currency EME bonds, the broad dollar index plays a similar role to a stock's beta in being a cross-sectional asset pricing factor (Bruno, Shim, and Shin, 2022). On the horizontal axis we plot the cross-sectional betas estimated from regressing the monthly JP Morgan GBI country index return

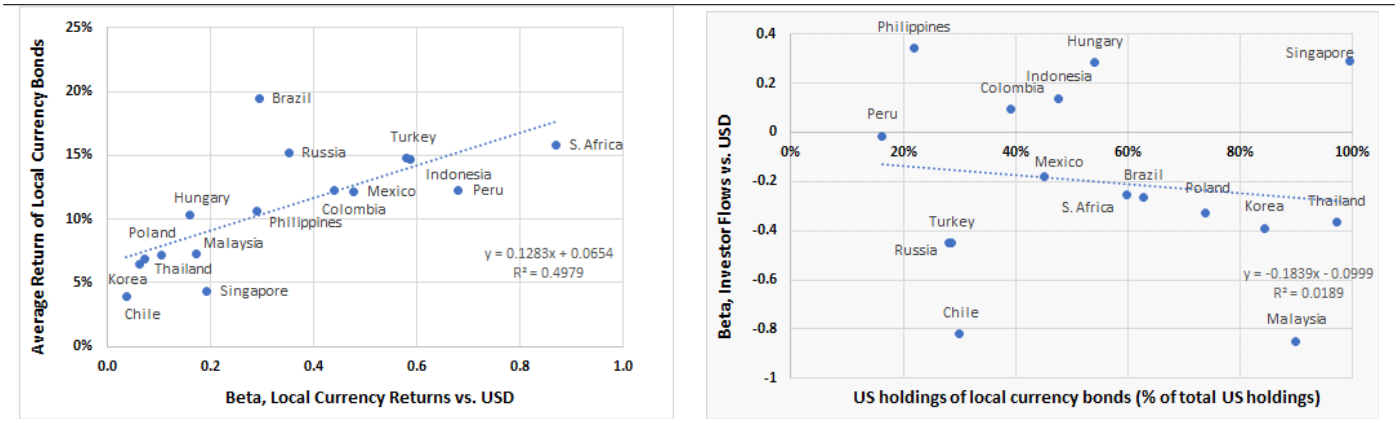


Figure 7: **Dollar Betas.** The left-hand panel of this figure shows the scatter plot of the dollar beta local returns in the horizontal axis and the average return of local currency bonds in the vertical axis. The right-hand panel of this figure shows the ratio of US total investment holdings in local currency bonds in the horizontal axis and the dollar beta investor flows in the vertical axis.

for local currency bonds over the broad US dollar index. In the vertical axis we plot the average monthly local currency return. When we consider the broad US dollar index as a global factor that enters as a cross-sectional asset pricing factor, we see that those countries whose bonds are more sensitive to the fluctuations of the broad dollar index tend to pay higher nominal yields.

Finally, we look at the countries where the effect of US dollar movements on flows are more potent. Figure 7, right-hand panel, plots on the horizontal axis the ratio of US holdings of local currency bonds to total US investment holdings. The vertical axis plots the cross-sectional betas estimated from regressing the monthly investor flows over the broad US dollar index. The negative slope coefficient (-0.18) indicates that investor flows seems to be more sensitive to dollar fluctuations in countries where they hold a larger proportion of local denominated bonds, thus potentially amplifying financial instability in those countries. Singapore appears to be an outlier; after removing Singapore, the slope coefficient becomes more negative (-0.48).

6 Dynamics of portfolio flows

The results presented in the previous sections illustrate the relationship between bond flows, yields, and dollar exchange rate fluctuations, controlling for factors that vary across countries or time thanks to the inclusion of country-investor type or year fixed effects. In this section we perform a complementary analysis that takes stock at a more causal interpretation of the results by using data at the monthly frequency. We utilize a variant of the monthly TIC portfolio data in Bertaut and Judson (2014, 2022), selecting only holdings of government bonds. The monthly data allow disaggregation by country.

Figure 8 shows the monthly fluctuations (in blue) of the net purchases (sales) of government bonds together with the percentage change in the broad US dollar index (in green) for Thailand and Malaysia. From the annual TIC annual survey data, we know that US investment flows into Thai government bonds are entirely denominated in local currency, and flows into Malaysian government bonds are between 97% and 100% denominated in local currency (Figure 13).

In Figure 8 we observe a negative correlation between US investment flows and the broad US dollar index. For Thailand (Malaysia), the contemporaneous correlation between US flows and the dollar exchange rate is -0.19 (-0.04), whereas the correlation between the dollar exchange rate and one-month ahead US flows is -0.12 (-0.18).

We estimate a structural panel VAR at the monthly frequency for the period from January 2012 to December 2022. Specifically, we run a multivariate panel regression of each dependent variable on lags of itself and on lags of all the other dependent variables using the least square dummy variable (LSDV) estimator (Cagala and Glogowsky, 2014).

Our empirical approach is to start with a 3-variables panel benchmark VAR model containing the following three variables of interest: US broad dollar index, US investment flows in government bonds, and local currency bond yields. We then augment the benchmark specification to take into consideration US monetary policy. We impose a Cholesky ordering, i.e., a variable that is higher in the ordering has a contemporaneous impact on subsequent variables, whereas variables that are lower in the ordering affect previous variables with a lag.

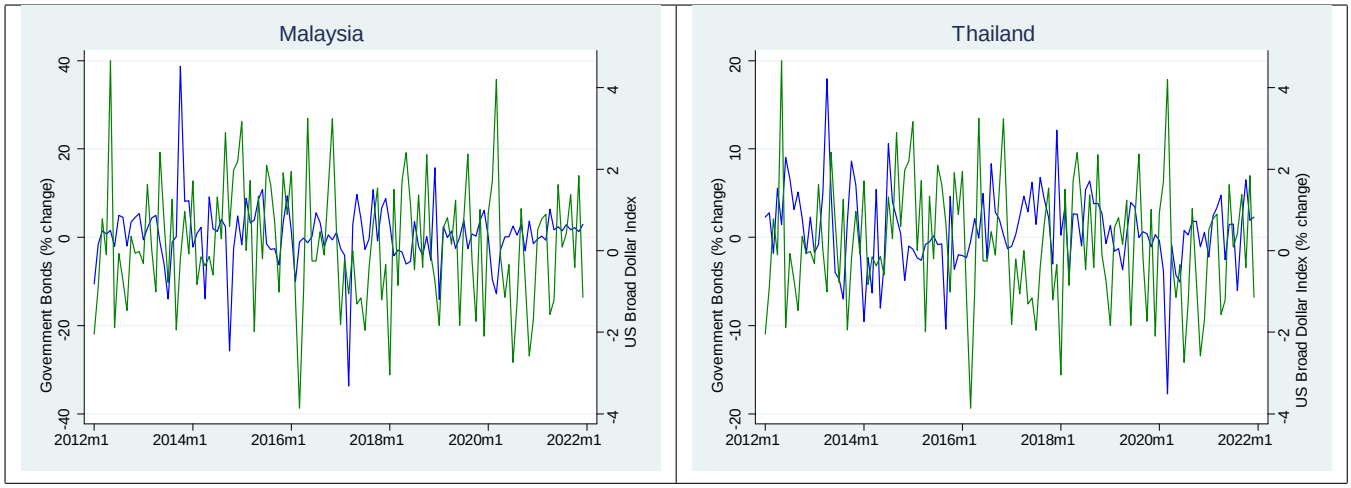


Figure 8: **Local currency bonds and the US dollar.** This figure shows the monthly net purchases (sales) of government bonds (left vertical axis, blue line) and the monthly percentage change of the US Broad dollar Index (right vertical axis, green line) for Thailand (left panel) and Malaysia (right panel).

The recursive order of the benchmark specification is as follows: the percentage change of the broad US dollar index (ordered first), US investment flows in government bonds of each country (ordered second), and country-specific local currency government bond yields (ordered last). For emerging markets in particular, it is reasonable to assume that their local conditions do not contemporaneously affect the US broad dollar. Instead, the broad dollar index is the global variable capturing global financial conditions that affect all other local variables. We order bond flows after the US dollar but before bond yields because we assume that dollar fluctuations will affect US investors' decisions on bond flows, which will in turn affect local currency yields. We use the Akaike Information Criteria (AIC) to select the lag length. In most cases, the optimal lag length is confirmed by the BIC and QIC criteria. We calculate the error bands using the Monte-Carlo simulation algorithm with 500 replications.

We construct monthly portfolio flows following the methodology described in Bertaut and Judson (2014; 2022). The monthly TIC data are collected in aggregate at market value and in US dollars (from SLT), and in these data it is not possible to directly measure valuation gains or losses on US investors' holdings. However, because the monthly data for US investor holdings of EME government bonds are collected from essentially the same reporter panels as the annual survey data, we can use information from the annual surveys to estimate monthly

valuation with considerable accuracy.[7] Our confidence in these monthly flows is supported by the fact that, when summed over the year, they are very close to the annual flows we measure directly from the individual bonds held as described in Section 2. We are able to construct our monthly measures of bond flows for the period 2012-2022.[8]

The local currency yields are obtained from the JP Morgan GBI-EM countries and taken from Bloomberg, except for Brazil, where we use a sample of bonds with closest maturity to five years, obtained from the central bank website. We restrict the analysis to the following countries: Malaysia, Singapore, Thailand, Korea, Brazil, Poland, South Africa, and Mexico. These are the countries where US investment holdings are mostly in local currency denominated bonds (Figure 13). Differently from the analysis using annual data, we do not know the investor type and the exact currency denomination of the bond flows at the monthly frequency. Thus, we chose this sample of countries because the variation in the monthly investment flows is most likely attributable to net sales or purchases of government bonds denominated in local currency.

During the period 2012 to 2022, the average (median) dollar percentage change was 0.2% (0.14%), with a standard deviation of 1.5%; the average (median) bond flows were 0.001% (-0.16%), with a standard deviation of 4%; the average (median) local yield was 4.6% (3.4%) basis points, with a standard deviation of 3.2%. Brazil had the on average the highest local currency yields (with peaks of 17%), while Singapore had the lowest on average (1.5%).

6.1 Baseline specification

Figure 9 shows the impulse response functions (IRFs) to one-unit shocks of the variables in the model, with 90% level for the confidence intervals.

The top panel reports IRFs to a one percent shock of the broad US dollar index and shows

[7] We first create country-specific price indexes as weighted averages of the respective JP Morgan GBI EM Index expressed in US dollars (for local currency bonds) and JP Morgan EMBIG Indexes (for US dollar-denominated bonds), using the annual survey data to determine the respective local currency and US dollar weights. We then apply the price indexes to the holdings data to determine how much of the monthly change in holdings arises from valuation change, with the residual change thus reflecting active (notional) portfolio flows. This method is similar to that used in Shek, Shim, and Shin (2018).

[8] Our sample period starts in 2012 because it is the starting year of the Bertaut and Judson (2014-2022) methodology, which in turn are based on the first full year of monthly holdings collected on TIC form SLT.

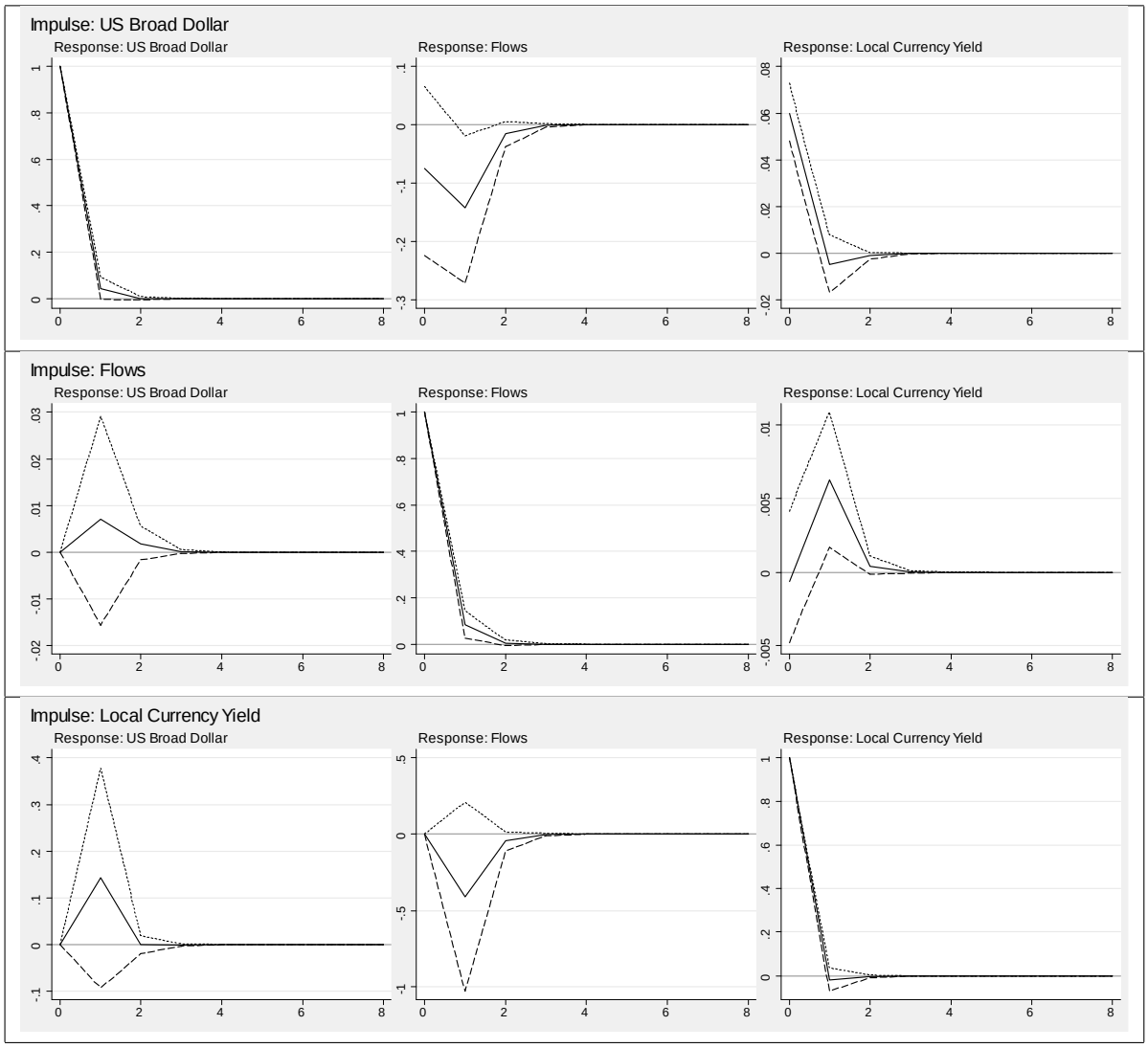


Figure 9: **Impulse response functions in recursive VAR - Sample of countries with US investments mostly in local currency bonds.** This figure presents estimated impulse-response function for the three variable recursive VAR model (Broad US dollar index, US investment flows in government bonds, and local currency yield) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, Thailand.

the core result of our analysis. A one percent appreciation of the dollar leads to a drop in local currency investment flows by 0.15% on average after one month (middle chart) and it is also associated with a simultaneous increase in local currency yields by 6 basis points (right chart). Put it differently, a one-standard deviation shock in the broad US dollar index leads to a drop in local currency investment flows by 0.22% after one month and a simultaneous increase in local yields by 9 basis points.

This evidence reaffirms the role of the US dollar exchange rate fluctuations as a global factor related to global portfolio investments. Under a portfolio approach, a broad based appreciation or depreciation of the dollar affects the lender's global portfolio, which is exposed to currency mismatches when investing in local currency bonds, and potentially setting off feedback loops on the lender's financial constraints.

6.2 The "wind chill" and "temperature" effects

The panel VAR analysis allows us to "shock" one variable at the time. In this section we attempt to quantify the combined effect on flows from a concurrent dollar appreciation and increase in local currency yields. In other words, we estimate the magnitude of the flows when both the exchange rate and the interest rate push or pull in the same or opposite directions. Specifically, we estimate a panel regression with country fixed effects where flows at month *t+1* are regressed on the dollar exchange rate, local yields (in first difference) and the interaction between the dollar and local yields at month *t*.

Figure 10 illustrates how a 1% increase in the broad US dollar is associated with flows (i.e., the slope) for different values of the change in local yields, from the largest negative change (i.e., decrease in yields) to the largest positive change (i.e., increase in yields) with 90% confidence intervals.

In the presence of both dollar appreciation and a positive increase in local currency yields, US investors sell local currency bonds at an increasing rate as the yield increases (right-hand side of Figure 10). In contrast, when the yield decreases, dollar appreciation is no longer statistically associated with outflows because exchange rates and yields are pulling into opposite directions: as dollar appreciation is generating a negative valuation effect, a

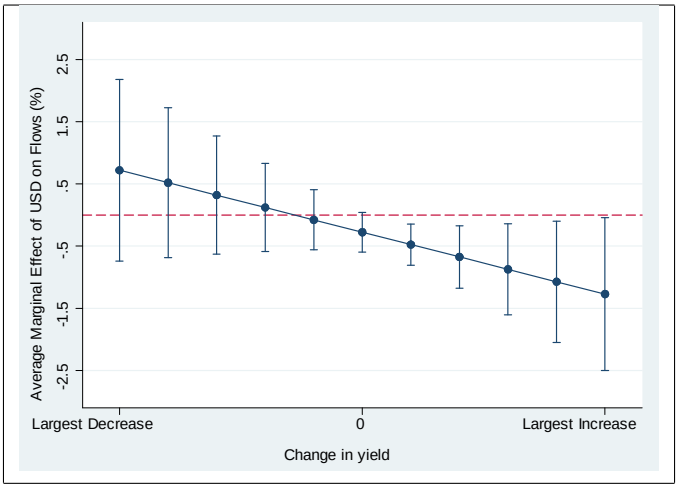


Figure 10: **The "wind chill" and "temperature" effects.** This figure presents the slope coefficients of 1 percent increase in the broad US dollar exchange rate on flows for a range of local currency yields, from the minimum first difference value (i.e., largest decrease) to the maximum first difference value (i.e., largest increase), for the subsample of eight countries where US investments in government bonds are largely denominated in local currency.

reduction in yields is increasing bond valuation (left-hand side of Figure 10).

Taken together, the evidence from Figure 10 highlights the US dollar "wind-chill" effect whereby investors who evaluate returns in dollar terms are affected both by the valuation effect due to dollar appreciation (the wind chill) on top of the underlying local currency bond returns (the temperature). When exchange rates and yields are pulling in the same direction, the effect on flows will be amplified. It indicates that dollar-based investors "suffer twice" as they must convert the local currency back to dollars at the lower rate, while dealing with higher local-currency spreads. Instead, when one of the two forces goes in the opposite direction of the other, the joint effect on flows seems to be nullified.

All in all, local currency bonds in EMEs may be riskier for global investors, who care about returns in dollar terms, than they are for local investors, who care about returns only in their own currency. Local currency bond issuance may protect the borrower from the direct effect of exchange rate fluctuations, however it may lead to higher bond price fluctuations, as also highlighted in Hale and Juvenal (2023). Monthly data do not allow for sectorial decompositions, however we can assume that any statistical effect would be driven by the

mutual fund sector given its large heft among all the investors.

6.3 The role of duration risk

A key result from the analysis using annual data (Table 4) is related to the association between dollar appreciation and outflows of local currency bonds with longer maturities. Here we show a complementary analysis in a panel VAR at a monthly frequency that confirms how duration risk is reflected in the flows.

Figure 11 (Panel A) shows the impulse response functions (IRFs) to one-unit shocks of the broad US dollar index on bond flows from countries with longer remaining maturity, computed at the yearly median across the sample of countries. In the top chart we see that a 1% dollar appreciation is statistically associated with a decline in investment flows with longer maturities, which is consistent with the evidence using annual data. The effect is immediate: as the dollar appreciates by 1%, flows drop by 0.4% at t=0 and by an additional 0.2% at t=1. As 1% appreciation of the dollar is also simultaneous to an increase in yields by 7 basis points, and each basis point increase in yields leads to a drop in bond flows by 0.9% after one month.

These results confirm that investors' outflows are larger where they face greater duration risk due to longer bond maturities–what we defined as a "double whammy" from duration and currency risk. Given the large heft of the mutual fund sector among all the investors, we can assume that the above evidence is largely driven by the mutual fund sector, consistently with the evidence in Section 3 that uses annual data.

Panel B shows the impulse response functions (IRFs) to one-unit shocks of the broad US dollar index on bond flows from countries with shorter remaining maturity (i.e., lower than the sample median). A 1% dollar appreciation does not have a statistically significant effect on investment flows.

6.4 US Monetary Policy

Exchange rates are not exogenous. Our focus has been on the amplification effects on bond flows coming from exchange rate fluctuations. Eichenbaum and Evans (1995) found that a

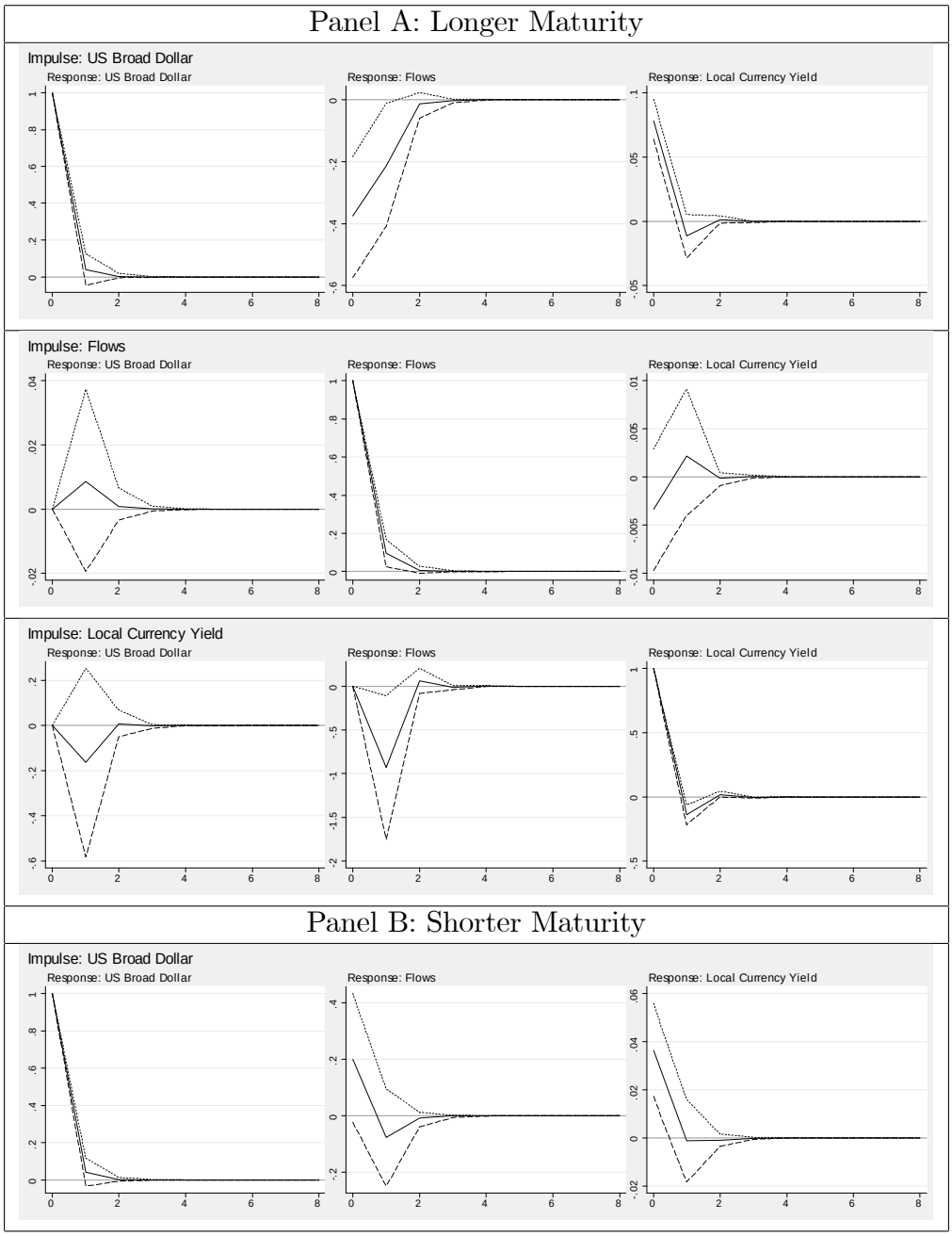


Figure 11: **Impulse response functions in recursive VAR - Duration Risk.** This figure presents estimated impulse-response function for the three variable recursive VAR model (Broad US dollar index, US investment flows in government bonds, and local currency yield) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, Thailand.

contractional shock to US monetary policy leads to persistent appreciation in the US dollar both in nominal and real terms. Chari, Stedman, and Lundblad (2021) finds a significant effect of US monetary policy on debt flows especially during stress like the Taper Tantrum period. We therefore augment our benchmark three-variable VAR by considering US monetary policy as global factor that affects US investors' decisions. As before, the sample is restricted to the eight countries with high US investment holdings mostly in local currency government bonds.

Figure 12, panel A, shows the impulse-response functions with 90% level for the confidence intervals from a four-variables VAR ordered as follows: US monetary policy, the US dollar, US investment flows in government bonds, and local currency yields. For US monetary policy variable, we use the monetary policy shock as constructed in Jarocinski and Karadi (2020). The top chart shows that, immediately following a US monetary policy shock, the US broad dollar appreciates, bond flows decline, and yields increase. The second chart shows that following dollar appreciation, flows drops after a month and yields go up at $t = 0$.

In Panel B, we limit the sample to bond flows from countries that have longer remaining maturity. Here we see the direct and large impact of the dollar on bond flows, while the US monetary policy variable looses its statistically significant impact on flows. Thus, panels A and B tell us the following narrative: an increase in the US monetary policy rate leads to an appreciation of the broad US dollar index, which in turn leads to a drop in investment flows, with an effect that is larger for longer maturity bonds. Taken together, this result confirms the effect coming from exchange rate fluctuations on investments decisions even after controlling for monetary policy shocks.

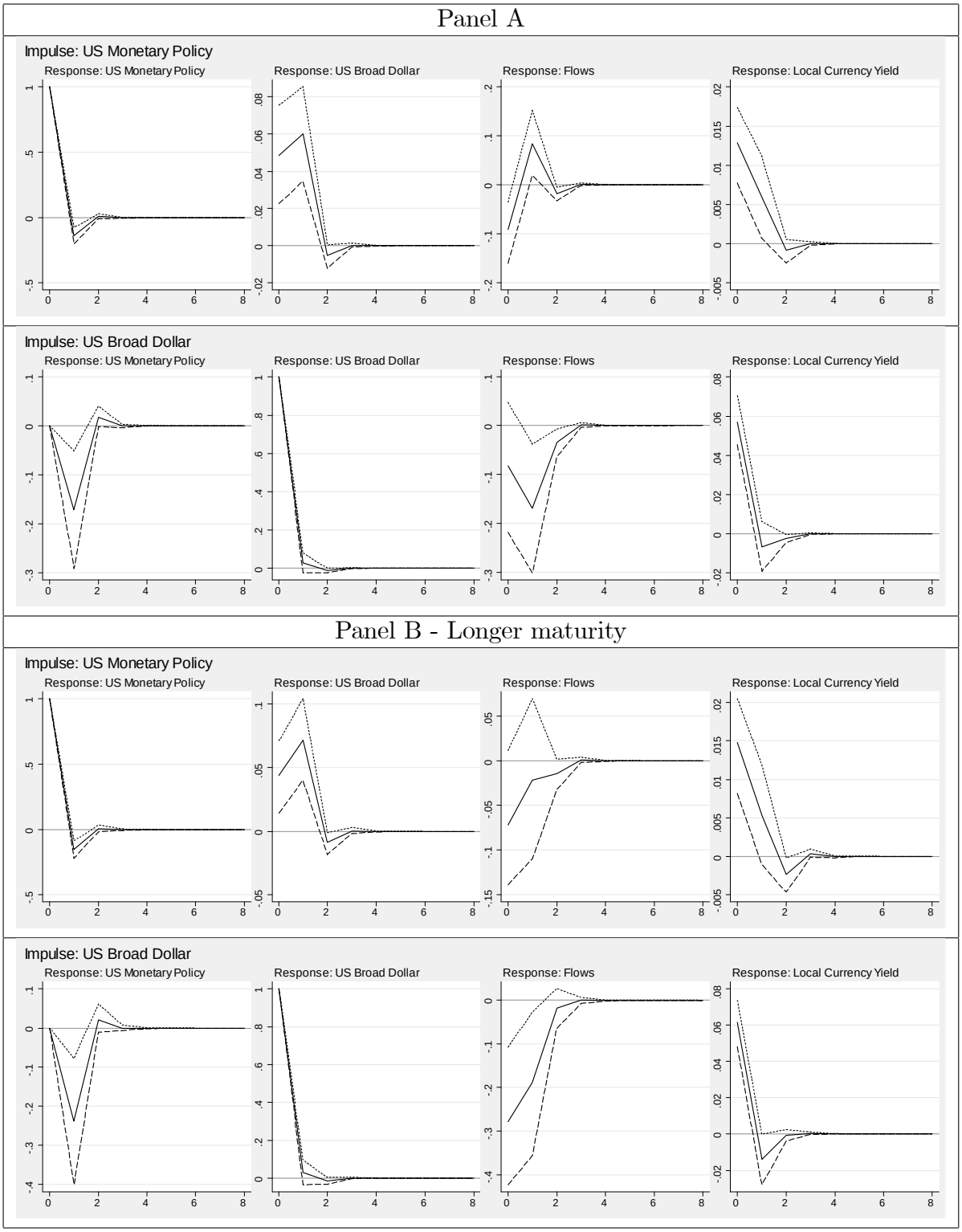


Figure 12: **Impulse response functions in recursive VAR - US Monetary policy.** This figure presents estimated impulse-response function for the four variable recursive VAR (US monetary policy, Broad US dollar index, US investment flows in government bonds and local currency spreads) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, Thailand. US monetary policy variable is the US interest rate suprise as computed in Jarocinski and Karadi (2020).

7 Concluding remarks

Our paper has examined the relationship between sovereign bond flows and global financial conditions by using a unique and comprehensive dataset that allows to study the comparative portfolio choices across all investor types and to make new discoveries by delving deeper into the aggregate trends. Emerging market governments have largely overcome Original Sin by issuing debt in local currency at increasingly long maturities. However, risk has not disappeared, but it has shifted from the borrower to the lender, thus leading the way to new vulnerabilities in financial markets. Duration risk has taken a central role with respect to traditional vulnerabilities related to foreign currency issuances, and it is particularly potent in its interaction with currency risk.

Mutual funds display a heightened sensitivity of portfolio flows to duration risk and exchange rate changes. Mutual funds flows of local currency bonds are the most sensitive to yield changes and show the greatest redemption activity that magnifies price reaction and generates larger outflows of local currency bonds when the dollar appreciates because of the higher degree of strategic complementarities. Other sectors, such as the pension and insurance sectors, as well as deposit-taking banks, do not display the procyclical tendencies seen in mutual funds.

In the case of dollar denominated bonds, long-term investors, such as pension funds and insurers, figure prominently as holders of US dollar denominated bonds. They tend to cushion the actions of mutual funds and alleviate portfolio flows procyclicality in the dollar denominated sovereign bond market. This finding highlights the possible clientele effect of particular investor sectors. Insurers have bond-like liabilities to policy holders, and their investment strategies are geared toward holding similar duration assets as a hedge against duration risk. Hence, EM governments that have issued dollar denominated bonds may benefit from more stable funding due to a "stickier" investor base.

Furthermore, mutual funds' behavior is different in the case of dollar denominated bonds because their returns are not subject to valuation effects due to exchange rate fluctuations that may be concurrent or amplify yield changes. For this reason, duration risk is more relevant for local currency than for dollar denominated bonds.

Our results thus run counter to the conventional wisdom that emerging market woes are mostly attributable to currency mismatch on the borrower's balance sheet, due to raising borrowing costs for the borrowing government through heightened risk premia following dollar appreciation, and perpetuating their reliance on foreign currency external debt. Local currency-denominated bonds of emerging markets, especially with longer maturities, appear to display greater sensitivity of flows to shifting financial conditions. Longer maturities mitigate rollover risk for borrowers, but this is achieved at the expense of greater sensitivity of bond prices to yield changes due to the greater duration risk for the investor.

To the extent that investor reactions amplify market disruptions, longer maturities may introduce new vulnerabilities with the potential to affect the availability and cost of finance. To the extent that market disruptions are made worse by duration risk, lengthening maturities may be associated with the arising of new market risks related to exchange rate fluctuations, and the way such selling pressures could affect the domestic yield curve even in the case of local currency issuances. The impact of duration risk and its interaction with currency risk emerges as a key area for further study with profound implications for macro stabilization.

Lastly, we identify longer-term shifts in the investor base in EME capital markets. We see that US mutual fund investors have progressively decreased their holdings in local currency bonds while increasing their holdings denominated in US dollars. This reflects the shift in the pattern of issuances from local currency to dollar bonds. In the period 2020 to 2022, the holdings in local and dollar currency by US mutual funds are essentially the same, after years when the holdings in local currency have been up to three times larger than those denominated in US dollar.

Even though emerging markets have largely overcome Original Sin by issuing sovereign bonds in local currency, the portfolio holdings of global investors have ebbed. Accordingly, domestic investors now account for a larger proportion of the amounts outstanding. In addition, about half of new sovereign debt issuance has ended up on domestic bank balance sheets between 2020 and 2021 (Obstfeld, 2021). In a period of higher long-term interest rates globally, the stakes have risen in governments being able to maintain fiscal sustainability.

Fiscal space has accordingly become more dependent on domestic investors to absorb greater issuance.

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A Appendix

A.1 Other global factors and country openness

Having established in Table 3 the consistent procyclical behavior to dollar fluctuations of mutual funds, and their significant impact on sovereign holdings both in terms of economic magnitude and size, in Table 9 we look at other global factors that may be related to investors' behavior and at possible country characteristics that accentuate such procyclical behavior. We use specification 4 where the dummy variable *Mutual* is equal to one for the mutual funds sector, and zero otherwise, interacted with Δ*USD Broad*. The reference group consists of all the other investor types (pension funds, insurance sector, and all others) for the period 2004-2022. This allows us to run a specification that includes both country-investor type and year fixed effects. The dependent variable is bond flows denominated in local currency.

Columns 1 and 2 of Table 9 replicate the analysis by using the broad US dollar for advanced economies (from the FED FRED, available since 2016). The broad US dollar for advanced economies should be a more "exogenous" proxy than the broad US dollar that includes both advanced and developing economies. The coefficient of *Mutual**Δ*USD Broad Adv Econ* is negative and statistically significant, confirming the procyclical behavior of mutual funds to dollar fluctuations, with and without year fixed effects.

Next, we use the bilateral exchange rate vis-a-vis the US dollar in lieu of the broad US dollar index. Our goal is to compare both the statistical significance and the magnitude of the exchange rate coefficients for the case of local currency bonds. In column 3 of Table 9, the coefficient estimate of Δ*Bilateral* is not statistically significant for the sample of investors excluding the mutual funds. When looking at the mutual funds sector, the total estimated coefficient of Δ*Bilateral* is -0.4 and statistically significant, which confirms that mutual funds have a procyclical behavior to country-specific exchange rate changes. However, the estimated coefficient of Δ*Bilateral* for the mutual fund sector is about a third of of the estimated coefficient of Δ*USD Broad* (-1.3, column 2 of Table 3). Furthermore, when adding year fixed effects, the total estimated coefficient for the mutual fund sector is no longer significant (column 4). This evidence suggests that a global factor is at play, namely global investors responding to risk-off and risk-on periods, and the broad US dollar index does have

Table 9: **Investor Type Analysis: Other global factors and country openness.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds denominated in local currency, for the period 2004-2022. ΔUSD Broad Adv Econ is the Broad US dollar index computed for advanced economies only, available since 2016. ΔBilateral is the annual percentage change in the bilateral exchange rate. ΔVIX is the change in the VIX index. US rate is the the Wu-Xia shadow federal fund rate. ΔUSD Broad is the annual percentage change in the Broad US dollar index comprising of sixty economies. Mutual is a dummy equal to 1 that identifies the mutual fund sector, 0 otherwise. All specifications include Driscoll-Kraay standard errors. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X Variable	ΔUSD Adv Econ		ΔBilateral ER		ΔVIX	US rate	ΔUSD Broad	
Countries	All	All	All	All	All	All	High fin openness	Low fin openness
X	-0.0314		-0.0842	0.1320	-0.0015	0.7580		
	[0.0870]		[0.0525]	[0.0881]	[0.0020]	[0.6635]		
Mutual*X	-1.1014*	-1.1082*	-0.3189	-0.3086	0.0027	1.0299	-1.2881**	-0.4393
	[0.5859]	[0.5837]	[0.1936]	[0.1936]	[0.0032]	[2.0962]	[0.5893]	[0.5616]
Constant	0.0656**	0.1727***	0.0814***	0.2205***	0.0913	0.0685***	0.4338***	0.0699**
	[0.0228]	[0.0164]	[0.0256]	[0.0058]	[0.0559]	[0.0221]	[0.0173]	[0.0244]
Obs.	961	961	1,047	1,047	1,047	1,047	516	531
Ctry-Inv FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE		✓		✓			✓	✓
Coeff. sum (X +Mutual*X)	-1.132	—	-0.403	0.114	0.001	1.788	—	—
p-value	0.080	—	0.065	0.683	0.790	0.504	—	—

a greater impact than the individual country exchange rate dynamics.

We then take a look at the VIX and US monetary policy as other potential global factors. Columns 5 and 6 show that changes in the VIX index or in the US monetary policy (US rate, captured by the Wu-Xia Shadow rate) are not statistically significantly associated with changes in the portfolio holdings on average across countries. The statistical insignificance of US monetary policy or the VIX index may be due to various reasons, including endogeneity or low data frequency.

Finally, in columns 7 and 8 we split the sample of countries according to the Chinn-Ito Index measure of financial openness. Countries with high (low) financial openness are associated with a normalized Chinn-Ito index greater (lesser) or equal to 0.5. We observe that the procyclical behavior of mutual funds is particularly accentuated in countries with greater financial openness, suggesting that restrictions to capital accounts seem to alleviate the transmission of global financial conditions related to dollar fluctuations.

A.2 Instrumental Variable Yield Analysis

As a follow-up analysis to Section 5.1 that examines the response of bond yields to US investors' flows, we run a two-stage IV regression where US mutual funds flows (scaled by the outstanding amount of the bond at t-1) denominated in local currency are instrumented by the broad dollar index constructed using bilateral exchange rates with for advanced economies ($USDNarrow$). As in specification (8), we also include GDP growth, Inflation volatility, and the 10 year US government bond, bond fixed effects, and standard errors are clustered at the bond level.

The first two columns of Table 10 report results for bonds with remaining maturity greater than five years (Long). The USD narrow exchange rate seems to be a good predictor of flows by mutual fund investors (first stage), with a Cragg-Donald Wald F statistic of 14.18 and a Kleibergen-Papp Wald F of 17.14. Importantly, the second stage shows that an increase (decrease) in US mutual funds bond flows is associated with a decrease (increase) in the bond yields. The effect is statistically significant (at the 1% level) and also economically important: every 1% redemption is associated with 2bp increase in the bond yield.

Table 10: **Yield Analysis: Local currency bonds.** This table shows IV analysis where mutual funds flows denominated in local currency are instrumented by the US narrow dollar index. Columns 1 and 2 report regressions for bonds' remaining maturities greater than five years, and columns 3 and 4 for bonds' remaining maturities less than five years. The sample period is 2004-2022. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)
	Long		Short	
	First stage	Second Stage	First stage	Second Stage
Dep variable	Flows	Yield	Flows	Yield
ΔUSD Narrow	-0.0099*		-0.0065	
	[0.0060]		[0.0069]	
$\widehat{Flows}$		-2.2445***		-7.7960
		[0.4365]		6.603
10 year US yield	-0.0016***		-0.0003	
	[0.0003]		[0.0003]	
Inflation Volatility	0.0009	0.0054***	-0.0001	0.2614
	[0.0006]	[0.0012]	[0.0004]	[0.3961]
GDP growth	0.0003***	0.0013***	0.0001	0.2465***
	[0.0001]	[0.0001]	[0.0001]	[0.0766]
Observations	2123	2,123	1,659	1,659

The third and fourth columns are for bonds with remaining maturity lower than five years (Short). The USD narrow index does not seem a good predictor of US flows and the Cragg-Donald Wald F statistic is equal to 0.76. The instrumented US flows in the second stage are not statistically significantly associated with bond yields.

Taken together, these results show that the price impact of sales is larger for longer maturity bonds, which is the crucial link to the strategic complementarity between US investors as their bond outflows are more sensitive to exchange rate fluctuations. Section 4 shows the fund-level analysis, where the average maturity of the bond fund operationalize strategic complementarity. Strategic complementarities in redemptions between mutual fund investors are found to be larger for bond funds with longer average maturity bonds, because the price decrease for any quantity of sales is larger.

A.3 US Investors holdings

Figure 13 shows the annual outstanding value of holdings by US investors and their net purchases (sales) of government bonds (USD million) for 16 EMEs, for dollar-denominated bonds and in local currency. The sample period is 2004-2022 and we exclude 2022 data of Russia due to frozen assets sanctions. US investor holdings are primarily in local currency bonds in Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa and Thailand. The top row shows trends for Malaysia, Singapore, and Thailand. For these three countries, US investors hold essentially only government bonds denominated in local currency; holdings of USD denominated bonds are zero or close to zero for the entire sample period.

The second row of Figure 13 shows trends for Korea, Brazil, and Poland. For Korea, US investor holdings of local currency bonds increase notably after 2008, and the share increases to about 90% of all Korean government bonds held by 2012. For Poland and Brazil, local currency holdings and shares also increase, from about two-thirds to between 80 and 85%, but then decline after 2014. The last row of Figure 13 shows the trends for South Africa (where the share increases from less than two-thirds to almost 80% after 2012) and Mexico (where it increases from between 50% to 70%). For this sample of countries, the volatility of purchases and sales of local currency bonds is striking, whereas transactions in USD denominated bonds are on average more stable.

Figure 14 shows the same information for Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia and Turkey. For this sample, the preponderance of local currency bonds in investor holdings is much less striking than for the countries in Figure 13. In fact, for countries like Peru or Philippines in the bottom row of Figure 14, US investors primarily hold government bonds that are denominated in US dollars.

The analysis in Section 3 groups depository institutions, non-financial institutions, other financial institutions, and other funds under one category (All others) due to data availability. For each of these component categories, we know the year-end holdings of government bonds of each issuer by currency of denomination starting in 2014.

The top panel of Figure 15 shows the outstanding market value (in USD billion) of government bonds denominated in local currency by each type of US investor for the period

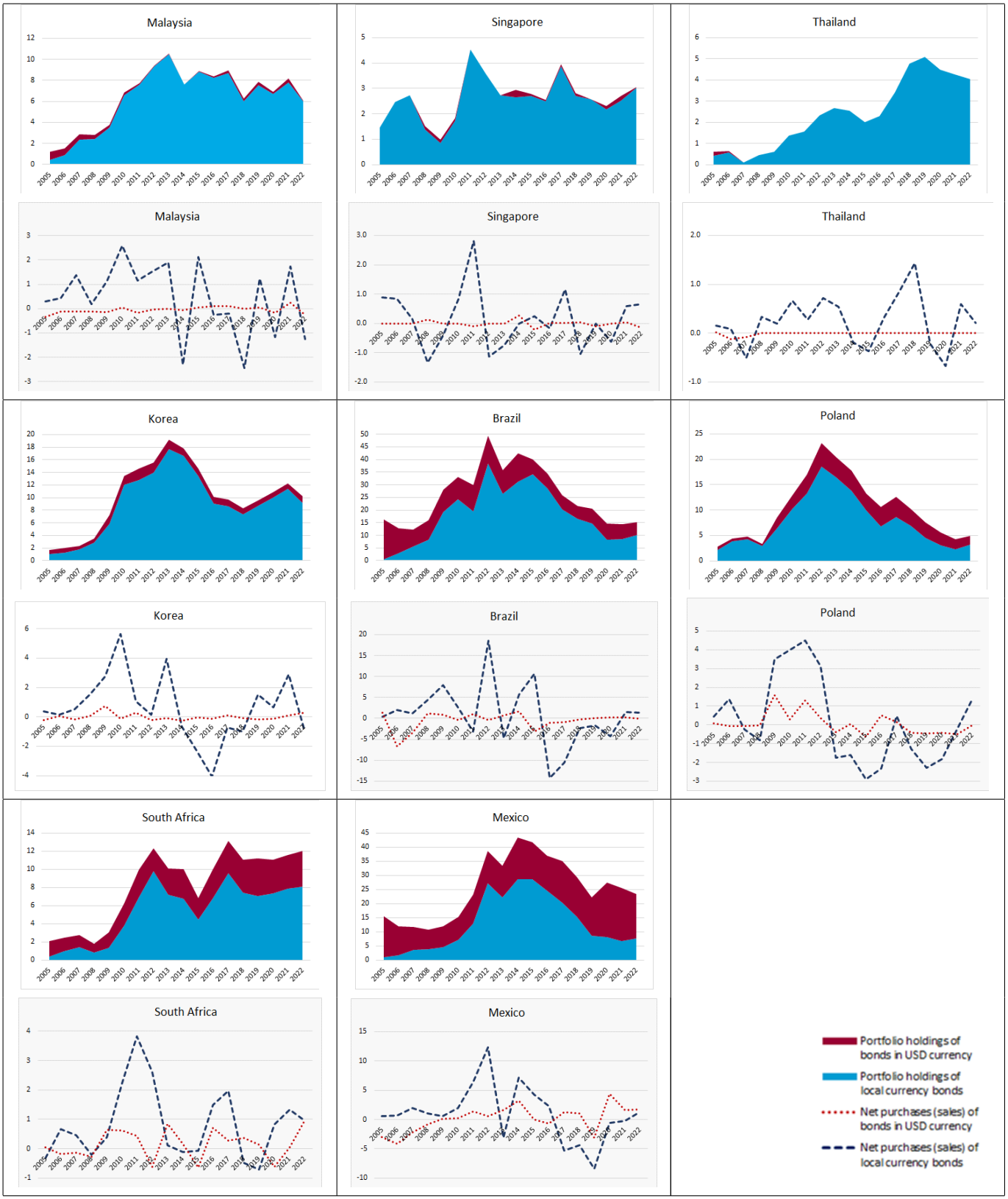

Figure 13: **High local currency holdings.** This figure shows a sample of countries where US investors mostly hold government bonds denominated in local currency. The areas capture the total value amount of holdings (USD billion). The dotted lines show net purchases (sales). Blue areas and lines indicate holdings and flows denominated in local currency. Red areas and lines indicate holdings and flows in USD denominated currency.

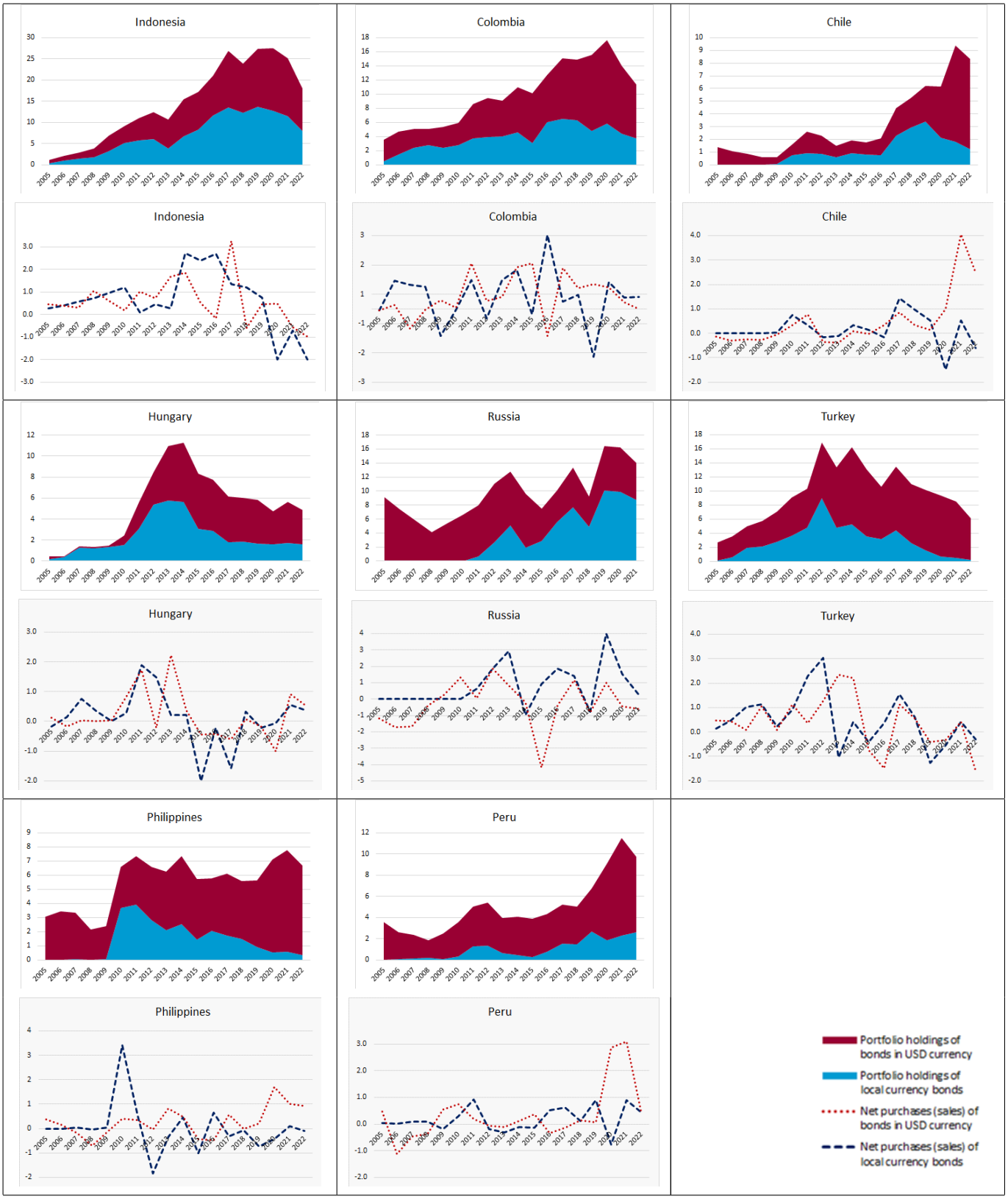

Figure 14: **Low local currency holdings.** This figure shows a sample of countries where US investors hold government bonds denominated in both USD and local currency. The areas capture the total value amount of holdings (USD billion). The dotted lines show net purchases (sales). Blue areas and lines indicate holdings and flows denominated in local currency. Red areas and lines indicate holdings and flows in USD denominated currency.

2014-2022. Within the category “All others”, which comprises of depository institutions, non-financial institutions, other financial institutions, and other funds, the depository institutions have the smallest share, with an average of 3% with respect to all US investors.

The sector "Other financial institutions" includes entities such as broker dealers and accounts on average for 6% of the EME local currency bonds held by US investors, though their holdings reach a peak of about 20% in some years in some countries such as Brazil, Colombia or Peru. Their holdings also vary somewhat from year to year. “Non-financial institutions” hold on average 7% of the total US investments in EME local currency bonds, with a significant presence in some countries like Chile and Mexico. “Other funds” includes entities such as hedge funds and account on average for 7% of the total US investments, with the largest increase happening in 2018, and they have their largest presence in countries like Chile, Peru, Hungary and Indonesia.

Figure 15 (lower panel) shows the analogous information, but for dollar-denominated bonds. Among the “All others" category, the "Other financial institutions" have on average the largest share of US investors across countries and years.

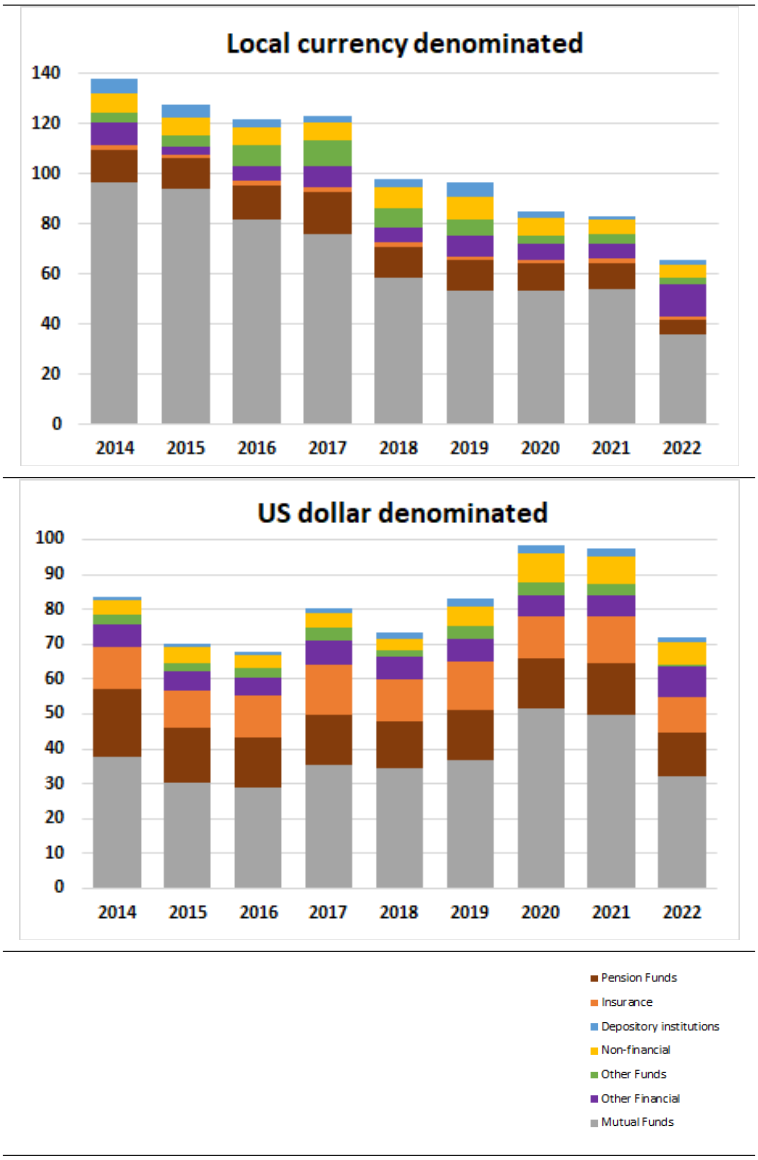

Figure 15: **Local currency and US dollar-denominated holdings by investor type.** This figure shows the holdings (USD billion) of government bonds that are denominated in local currency or US dollars for our sample of sixteen EMEs by type of investor over the period 2014-2021: Mutual Funds, Pension Funds, Other Funds, Depository Institutions, Other Financial Institutions, Non-financial institutions, and Insurance.

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