# Original Sin Redux: Role of Duration Risk*

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July 4, 2023

**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 roll-over 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 from the nonbank financial sector.

**Keywords**: portfolio flows, local currency bonds, non-bank financial intermediaries
**JEL codes:** F65, G23, H63

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*The views expressed here are those of the authors, and not necessarily those of the Bank for International Settlements or the Federal Reserve System. We thank Beau Bressler, John Caramichael, Collin Coil, Emily Liu, and Jimmy Shek for help with data. We also thank Wenxin Du (discussant), Galina Hale (discussant), Helene Rey, Ilhyock Shim, Frank Warnock (discussant), and participants at the 2021 CEPR European Summer Symposium in International Macroeconomics, the 2021 AEA meetings, the 2022 joint BIS, BoE, ECB, IMF Spillover Conference, and the 2022 joint BoE, BdF, IMF, OECD, BdI 3rd Workshop on International Capital Flows and Financial Policies for comments and suggestions. This paper received support by the National Science Foundation under Grant 2048754. Corresponding author: Hyun Song Shin, Bank for International Settlements, Centralbahnplatz 2, Basel, Basel-Stadt 4002, Switzerland. Email: hyunsong.shin@bis.org

# 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 stimulated the debate about the benefits of financial globalization (Obstfeld, 2009). Nevertheless, currency risk was shifted rather than eliminated. Carstens and Shin (2019) coined the term "Original Sin Redux" to denote the shift in currency mismatch risks from borrowers to investors.

In this paper, we shed light on the consequences of this redistribution of currency risk in global capital markets and 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 also lies at the heart of market dynamics of emerging market sovereign bonds.

Duration and currency risk is borne by investors in the first instance, but since the sovereign yield curve underpins domestic monetary 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 (Hale and Juvenal, 2023). Borrowing in domestic currency 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

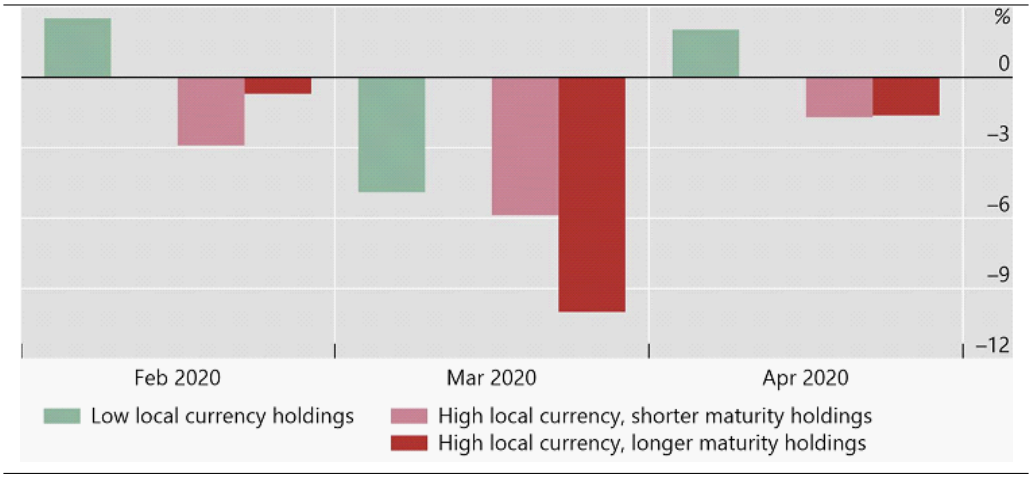


Figure 1: **March 2020 Episode.** This figure shows the average of the net purchases of sovereign bonds as percent of holdings by US investors from February 2020 to May 2020 for a sample of 16 EMEs. The sub-sample "High Local currency holdings" consists of countries above the median of the US local currency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

by investors in the United States expressed as a percentage of holdings in 16 countries. The bonds are partitioned into two groups of issuing countries: those where US investors 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.

In contrast to most existing studies of EME portfolio flows that focus 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) data on cross-border portfolio flows. 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 of previous studies. The TIC dataset also allows us to measure directly the shifts in portfolio holdings rather than relying on inferred holdings from the fund redemption flows.

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. The seven investor sectors are: pension funds, insurance companies, depository institutions, non-financial investors, "other funds" (e.g., hedge funds), "other financials" (e.g., broker-dealers), and mutual funds. Our sample of destination countries covers 16 major emerging market economies for the period 2004 to 2021. In the second part of the paper, we present a complementary analysis using a structural panel VAR to uncover some of the key forces that inform a causal interpretation of the results and look at the interaction between interest rates, exchange rates, and portfolio flows.

We highlight three notable findings.

First, duration risk emerges as a key channel for the transmission of market conditions in portfolio flows. This is the most notable finding of our paper. Emerging market sovereigns have joined the trend of borrowing at longer maturities taking advantage of yield chasing behavior set off 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, have taken center stage in market condition dynamics.

Duration risk is particularly potent due to its interaction with currency risk. Our working

hypothesis is that investors do not pre-hedge the currency risk when entering the local currency bond market, and instead aim to time the market and benefit from a stronger local currency even as the yields fall. Global portfolio investors evaluate their returns in dollar terms (or in other hard currency terms), so that exchange rate fluctuations that accompany yield changes tend to amplify duration risk. The combination of duration and currency risks generates a "wind chill" effect that weighs on investors and elicits portfolio adjustments that further amplify shocks.

Second, mutual funds are not typical of other investor sectors and they tend to exhibit much greater sensitivity to shifts in financial conditions. Mutual funds substantially reduce their holdings of local currency bonds following dollar appreciation, and do so much more than other sectors especially for longer maturities bonds.

The greater sensitivity of mutual fund outflows to shifts in financial conditions is consistent with the arguments in Chen, Goldstein, and Jiang (2010), who relate the flow dynamics to strategic complementaries and financial fragilities, and in Falato, Goldstein, and Hotacsu (2021) who highlight the role of open-ended bond funds in the propagation of financial stress during the COVID-19 crisis. To the extent that investor reactions to duration risk amplify market disruptions, lengthening maturities may increase the sensitivity of the domestic yield curve to global financial conditions.

In contrast to the mutual fund sector, other investors exhibit a lower sensitivity to changes in financial conditions, and tend to maintain a steady portfolio. Indeed, for some sectors, there is evidence that they take the other side of the exposures shed by the mutual fund sector. For this reason, aggregate portfolio flows are less procyclical than studies of mutual funds alone would suggest. Nevertheless, the large heft of the mutual fund sector leaves a strong imprint on aggregate flows.

Third, we identify longer-term shifts in the investor base in EME capital markets. Even as emerging markets have largely overcome Original Sin by issuing sovereign bonds in local currency, the portfolio flows due to foreign investors have ebbed. Notably, we find that domestic investors absorb most of the sell-off of local currency bonds by foreign investors. This may eventually bring back risk from the lender to the borrower, 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). In this respect, fiscal space for the government has become more dependent on domestic investors to absorb greater issuance.

In terms of currency denomination, we see that US mutual fund investors have progressively decreased their holdings in local currency bonds while slowly but steadily increased their holdings denominated in US dollars. This reflects the shift in the pattern of issuances from local currency to dollar bonds. In 2020 and 2021, 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. Long-term investors, such as pension funds and insures, also 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.

Our study contributes to the literature on the feedback effects between capital flows and exchange rates, including seminal papers (e.g., Hau and Rey, 2004; Kaminsky and Reinhart, 1999) and other more recent influential studies (e.g., Gabaix and Maggiori, 2015; Ilzetzki, Reinhart, Rogoff, 2019). Due to data limitations, only a few papers have looked at the currency denomination of government bonds (e.g., Burger and Warnock, 2007; Hale and Spiegel, 2012; Du and Schreger, 2016; Burger, Warnock, and Warnock, 2018; Hofmann, Shim, and Shin, 2020, Boermans and Burger, 2023). Maggiori, Neiman, and Schreger (2020) use holdings of mutual funds to establish that currency is an important factor shaping global portfolios. Our analysis and unique data comprising of the entire US investor base add significantly to the debate on the role and risks posed by nonbank financial sectors for global financial stability and the role of mutual funds in amplifying such risks, especially in the case of bonds with longer maturities.

Taken as a whole, our findings run counter to the presumption that emerging market woes are due mainly to EM governments borrowing in foreign currency because local currency flows display sensitivity to shifts in global financial conditions. The novelty of our findings also run counter to the presumption that longer maturity debt alleviates vulnerabilities. Given that risk has to do with market risk due to the higher duration, it is instead very natural that the

raise of new vulnerabilities is associated with longer maturity debt. Our findings highlight the importance of market risk as compared to the traditional vulnerabilities like currency mismatch or maturity mismatch, a theme that is at the core of the current debate after the September 2022 turmoil in UK gilts and the Silicon Valley Bank blowup in March 2023.

# 2 Economic channel and dataset

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 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", and many EMEs have overcome the sin and improved foreign participation by reducing macroeconomic instability.

Indeed, 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 among emerging markets in terms of riskiness (duration and currency risk) of local currency government bonds. Lee (2022) finds that EM sovereigns borrow even 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. 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 persists 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 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.

We can delve deeper into the aggregate trends by utilizing the micro-level TIC data for the United States on cross-border portfolio flows. The comprehensive coverage of our dataset across all investor types 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 disaggregation by country and maturity.

Thanks to our comprehensive data that disentangle the currency denomination from underlying returns in domestic currency, we can address Original Sin Redux (Carsten and Shin, 2019) and pinpoint the economic channel at play. During tranquil periods associated with strong portfolio inflows, yields fall and emerging market currencies appreciate. However, during periods of financial stress, portfolio outflows go hand-in-hand with rising yields and a depreciating currency (Hofmann, Shim, and Shin, 2020; IMF, 2020).

Figure 2 illustrates the relationship between local currency yields and exchange rates. The variable *Yield* is defined as the first difference of the 5-year local currency bond yield (in percentages). The left-hand panel shows the monthly change in the local currency yield (in blue) together with the percentage change in the broad US dollar index (in red) for Malaysia. We observe a positive correlation between the two series (0.31), meaning that the yield of Malaysian government bonds increases as the dollar appreciates. A positive correlation exists for all countries in our sample, and it is even stronger for countries like Indonesia (yield-dollar correlation=0.48), Mexico (yield-dollar correlation=0.50), or Colombia (yield-dollar correlation=0.41).

The right-hand side of Figure 2 shows the fitted values from a specification where the change in local currency yield is regressed over the percentage change in the broad US dollar for the entire sample of 16 EMEs, with standard errors clustered at the country-level, with 95% confidence

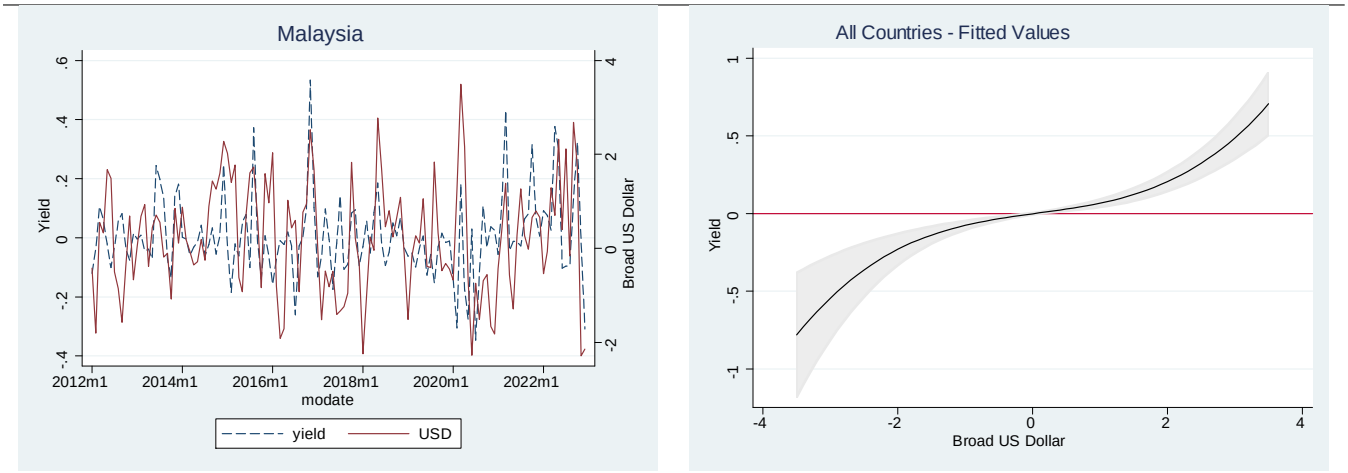


Figure 2: **Dollar-Yield nexus.** The left-hand panel shows the monthly change in the yield of the 5-year local currency bonds of Malaysia (Yield, left vertical axis, blue color) and the percentage change in the broad US dollar index (right vertical axis, red line). The right-hand panel shows the fitted values of a specification for 16 EMEs where the change in the weekly local currency yields is regressed on the broad US dollar percentage change, with 95 percent confidence levels. The period is 2012-2022.

levels, and with the inclusion of a cubic term of the broad US dollar to take non-linearities into account. The chart shows a positive correlation between dollar appreciation and the increase in the local currency yield. We also see a non-linear element at the extremes, where big changes follow a steeper relationship. The message from Figure 2 is that following dollar appreciation US investors "lose twice", as they must convert the local currency back to dollars at the lower rate, while the local currency price of the bond will have fallen in response to an increase in interest rates.

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, recently brought to the surface by the gilt market stress in the UK in September 2022, as well as the failure of Silicon Valley Bank in March 2023, and how duration risk lies at the heart of the market stress dynamics of emerging market sovereign bonds.

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 use the broad US dollar index as an indicator capturing global financial conditions. The strength of the US dollar has attributes of a barometer of dollar credit conditions, with a stronger dollar associated with tighter dollar credit conditions (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. Exchange rate fluctuations elicit global investors' portfolio rebalancing aimed at mitigating the risk exposure changes due to price and exchange rate changes (Camanho, Hau, and Rey, 2022). 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.

Our dataset also helps better understanding the increasing role played by foreign investors in local currency sovereign debt. Onen, Shin, and von Peter (2023) provide a new BIS dataset on long-term EME bond holdings by global investors, distinguishing the residence dimension from the currency dimension. Figure 3 is taken from Onen, Shin, and von Peter (2023), which shows how the bulk of EME government bonds is denominated in local currency, which have surged in recent years (left-hand side panel). Foreign holdings of EME government bonds have also increased over time for the BIS sample of 25 countries. Foreign currency bonds are typically held by foreign investors (right-hand side panel), who also hold a significant share of local currency bonds, about 11% (7%) of the aggregate outstanding local amounts in 2012 (2021).[1]

Some of the increase in local currency issuances has been absorbed by non-resident investors.

[1]There is a significant heterogeneity across countries. For our sample of countries, Arslanalp and Tsuda (2014, December 2021 update) show that the share of foreign currency debt has decreased from 83% to 31% in Chile, from 80% to 48% in Peru', and from 42% to 23% in Indonesia. Turkey is the only country with a reverse trend, where the share of foreign debt has actually increased from 17% to 54% during the period. Countries like Malaysia, Thailand, Brazil, Poland, and South Africa have been able to issue for the most in local currency since 2005.

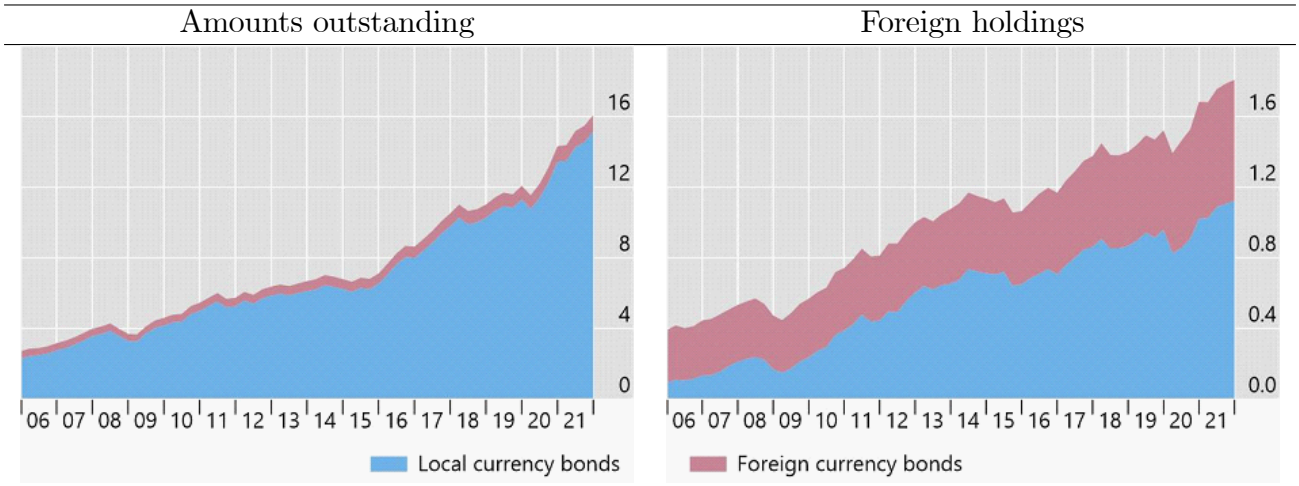


Figure 3: **Emerging market government bond markets by currency.** The left-hand panel shows the outstanding amounts of emerging market government bonds by currency and for a balanced panel of 25 countries, in trillions of US dollars. The right-hand panel shows the foreign holdings of emerging market government bonds, in trillions of US dollars. Source: Onen, Shin, and von Peter (2023).

For instance, in the case of Malaysia, Thailand, or Brazil, domestic investors held more than 95% of government debt securities denominated in local currency as of 2005. Instead, by 2021 foreign investors have increased their holdings in local currency bonds by more than 10% in those countries. In countries like Colombia, Peru, South Africa, and Mexico, foreign holdings of local currency bonds range between 49% and 20% of the total local currency bonds.[2]

US investors play a prominent role among the non-resident investors. Figures 17 and 18 presented in the Appendix show the annual outstanding value of holdings 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. 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

[2] Arslanalp and Tsuda (2014) highlight a reversal in some countries since the peak in local currency debt hold by foreign investors. For instance the share of local currency debt hold by the domestic sector jumped from 67% to 81% in Indonesia, from 54% to 80% in Mexico and from 77% to 96% in Turkey.

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.

In addition to the investor, currency, and maturity dimensions, our dataset has two further 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).

## 2.1 A look at the investor data

The top panel of Figure 4 shows the outstanding market value (in USD billion) of local and USD currency government bonds by type of investor since 2004. The investor types are: mutual funds, pension funds, insurance companies, and other investors comprising of 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.

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.[3]

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. However, we will see below that notional holdings amplify the valuation effects. 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

[3]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."

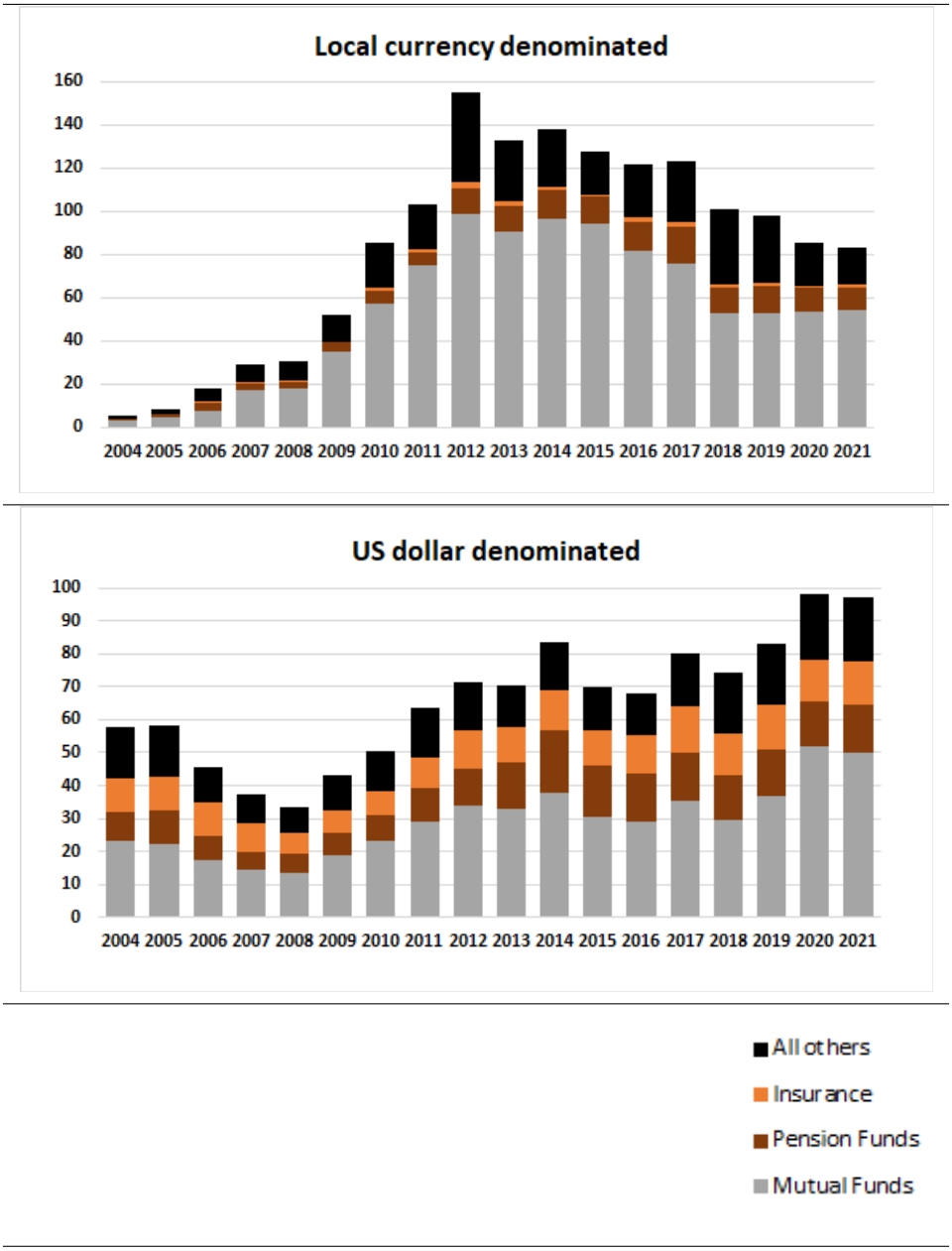


Figure 4: **Local currency and US dollar bond holdings by investor type.** This figure shows the holdings (USD billion) of government bonds that are denominated in local currency or US dollars for our sample of sixteen EMEs by type of investor: Mutual Funds, Pension Funds, Insurance, and All Others. All Others comprises Other Funds, Depository Institutions, Other Financial Institutions, and Non-financial institutions.

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 billion in 2014, but fell to about 53 USD billion by 2018 and remained constant in the subsequent years.

Figure 4 (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, and then sharply increase in the last three years (2019 -2021).

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 4 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 19 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

Table 1 presents evidence from a panel regression analysis of the cross-section sensitivity of flows by investor types: mutual funds, pension funds, insurance, and all others. The focus is on how investor flows fluctuate with shifts in the dollar exchange rate. Our focus here is on the longer time series since 2004 given the annual frequency of our data and the very large cross-sectional heterogeneity within the "All others" investor types within countries, and with quite small holdings in some cases.

In columns 1 to 6, the dependent variable is the change in notional holdings (that is, flows) of emerging market government bonds denominated in local currency, by investor type-country, for the period 2004-2021. Notional holdings control for valuation effects due to changes in yields and

Table 1: **Investor Type Analysis.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds by investor type and denominated in local currency (columns 1 to 6). In column 7 the dependent variable is the annual percentage change of each investor's annual investment in local currency scaled by the total aggregate local currency investments in a country. The investor types are: mutual funds (Mutual), pension funds (Pension), insurance companies (Insur), mutual funds, and All others (depository institutions, non-financial investors, other funds, other financials). USD Broad is the annual percentage change in the Broad US dollar index. All specifications include country-investor type fixed effects and Driscoll-Kraay standard errors. The sample period is 2004-2021. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Dependent variable | Local | Local | Local | Local | Local | Local | Local |
| Sector | All | Mutual | Non-Mutual | All | All | All | All |
| $\Delta$USD Broad | -1.4550 | -2.5729*** | -1.0742 | -2.5729*** | -2.6822*** | | -2.8155*** |
| | [0.8477] | [0.8743] | [0.9069] | [0.0000] | [0.6883] | | [0.8372] |
| Mutual*$\Delta$USD Broad | | | | | | -1.4518* | |
| | | | | | | [0.7052] | |
| Pension*$\Delta$USD Broad | | | | 1.2682 | 1.1991 | | 1.6422** |
| | | | | [0.8935] | [0.9063] | | [0.6300] |
| Insur*$\Delta$USD Broad | | | | 1.0853 | 1.0600 | | 1.3530 |
| | | | | [0.9904] | [1.0134] | | [0.8610] |
| All Others*$\Delta$USD Broad | | | | 2.1300** | 2.1171** | | 2.1603** |
| | | | | [0.9661] | [0.9556] | | [0.7827] |
| GDP Growth | | | | | 3.5631*** | | |
| | | | | | [0.8307] | | |
| Inflation Volatility | | | | | 0.0784 | | |
| | | | | | [0.0666] | | |
| Current Account | | | | | 0.8692 | | |
| | | | | | [0.6746] | | |
| Constant | 0.2169** | 0.2569** | 0.2032** | 0.2169** | 0.0551 | 0.4367*** | 0.0995 |
| | [0.0884] | [0.1068] | [0.0861] | [0.0884] | [0.0810] | [0.0224] | [0.0984] |
| Country-Inv Type FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | | | | | | ✓ | |
| Obs. | 1,010 | 257 | 753 | 1,010 | 1,006 | 1,010 | 963 |

exchange rates, and thus are a better reflection of the underlying portfolio adjustment decisions.

Changes in notional holdings (i.e., flows) are constructed directly from the underlying security-level data on US investor holdings. In the TIC 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. These flows are regressed on the percentage change in the broad US dollar index ($\Delta$ *USD Broad*). The specification includes country-investor type fixed effects and Driscoll-Kraay standard errors. We exclude outliers at the 0.5 percentile level.

Column 1 reports the result for all US investors. We note that the coefficient of $\Delta$ *USD Broad* is negative and not statistically significant, indicating that investor flows on average do not seem to respond to shifts in the broad dollar index with a statistically significance at the annual frequency.

However, the mutual fund sector shows a particularly strong relationship between a stronger dollar and a contraction in investor flows. In column 2, when we limit the sample to mutual funds only, the coefficient estimate of $\Delta$ *USD Broad* is negative and highly statistically significant at the 1% level. A one percent appreciation in the broad dollar index is associated with a 2.6% decrease in mutual funds flows. Thus, during periods of dollar appreciation, the market value of holdings in dollar terms contracts for two reasons: the valuation impact as well as the decline in notional holdings. Column 3 confirms that such a pattern is limited to the mutual funds sector and does not apply to the non-mutual fund sectors on average as the coefficient estimate of $\Delta$ *USD Broad* related to the sample of non-mutual fund sectors is not statistically significant (p-value=0.25).

We delve deeper by examining each US investor type by interacting the US dollar in sequence with a number of dummy variables (one for each investor type). The dummy variable takes value 1 for a specific investor type, and 0 otherwise. The default sector is the mutual fund sector, so that the size of the coefficient $\Delta$ *USD Broad* reflects the difference of each sector from the

mutual fund sector.

Column 4 shows the results of this panel analysis. The coefficient for $\Delta$*USD Broad* for the mutual fund sector is negative and statistically significant, whereas for all other US investor types, the aggregate effect (estimated by the sum of $\Delta$*USD Broad* and the respective interaction term) is not statistically significant at the annual frequency. 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, column 5 includes 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. Our results remain unchanged, and we see that faster economic growth is the most economically significant local factor for this sample of countries and time period.

In columns 1 to 5 we could not include year fixed effects because $\Delta$*USD Broad* would drop due to collinearity. Hence, in column 6, we run a slightly different specification. Specifically, we use the dummy variable *Mutual* that is equal to one for the mutual funds sector, and zero otherwise, interacted with $\Delta$*USD Broad*. The reference group consists of all the other investor types (pension funds, insurance sector, and all others aggregated) for the period 2004-2021. This allows us to run a specification that includes both country-investor type and year fixed effects. Column 6 shows that the coefficient *Mutual**$\Delta$*USD Broad* is negative and statistically significant also under this specification, confirming the strong procyclical behavior of mutual funds to dollar fluctuations.[4]

Finally, column 7 confirms that our evidence is robust to constructing the dependent variable differently. Here, investment flows are captured by the total amount of investment in local currency by each type of US investor in a given country, scaled by the total outstanding amount of local currency bonds of a given country, and then taking the percentage change. The sign and magnitude of the coefficients for $\Delta$*USD Broad* are very similar to the estimations in column 4.

Note that, as in columns 4 and 5, the coefficient estimate of the variable *All Others* is positive

[4]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.

and statistically significant, meaning that, following dollar appreciation, mutual fund flows on average sells local currency bonds whereas other investor types (depository institutions, non-financial entities, other funds or other financials, depending on each country) buy some of them.[5] Pension funds also seems to have a role as buyers of local currency bonds. However, the size of the pension fund and other sectors is significantly smaller than the mutual fund sector (Figure 4), and the larger heft of the mutual fund sector leaves a stronger imprint on the aggregate flows. We will further explore the buyer side in Section 3.3.

In Table 6 presented in the Appendix we show that the procyclical behavior of mutual funds is accentuated in countries where the foreign investors presence is high and in countries with greater financial openness.

Overall, the message is that the local currency-denominated flows of the mutual fund sector (the largest holders of emerging market sovereign bonds) displays a strong sensitivity to dollar fluctuations, adding weight to the risk-taking channel discussed in Bruno and Shin (2015a, 2015b). 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 EME bonds as a whole. These findings underscore the role of the broad dollar index as a barometer of risk appetite.

## 3.1 Duration risk and amplification effects

Table 1 has highlighted the distinct procyclical behavior by mutual funds. In this section we delve deeper into the mutual funds behavior and the potential associated risks. EMEs have been able to fulfill investors' search for the yield by issuing longer maturity bonds, especially after the 2007 financial crisis. Longer maturities mitigate rollover risk for the borrower, however risk does not disappear, but it is transferred to the investors who are now subject to a greater duration risk.

[5] 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).

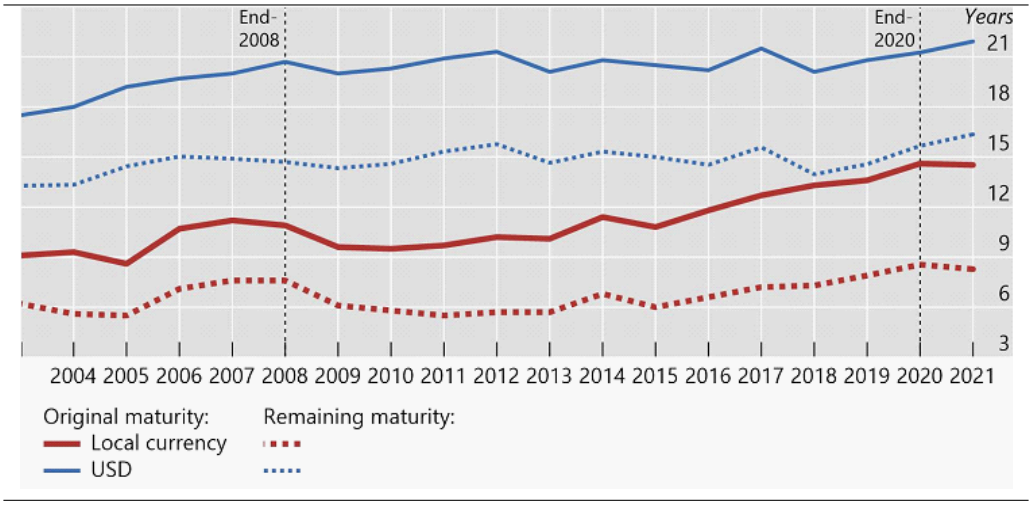


Figure 5: **Local currency and US dollar bond holdings by maturity.** This figure shows the mean value of maturity at issuance (solid lines) and the mean value of the remaining maturity (dash lines) of government bonds denominated in US dollar (blue color) or in local currency (red color) for our sample of sixteen EMEs over the period 2003-2021.

Figure 5 shows the mean value of maturity at issuance in years and the mean value of remaining maturity of bonds denominated in US dollar or in local currency and 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, these countries have been able to issue bonds at longer maturities, with an especially noticeable increase for local-currency bonds. Specifically, the mean bond maturity at issuance of local currency bonds jumped from 9 years in 2003, to 14 years in 2020 and 2021.

There is a considerable variability by country, even among countries where holdings are primarily in dollars. Overall, 25 percent of dollar-denominated bonds held by US investors have a remaining maturity of over 23 years. Remaining bond maturity is notably shorter for own-currency denominated bonds. Here too there is considerable variability by country, even among countries that borrow primarily in own currency. The mean remaining maturity is about 6.7 years. For about half of local-currency borrowers the median remaining maturity is less than 3 years, and for the rest the remaining maturity is more than 6 years.

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 denominated in local currency by country-year and split them according to their remaining maturity greater or lower than 5 years. Table 2 shows the results from a regression with country fixed effects where the flows with remaining maturity greater (column 1) or lower (column 2) than five years are regressed over the change in the broad US dollar index.

In column 1 we see that the coefficient estimate of $\Delta$*USD Broad* is -2.8 and statistically significant at the 1% level, meaning that mutual funds flows of bonds with longer maturities have outflows by 2.8% following 1% dollar appreciation. In contrast, in column 2 the coefficient estimate of $\Delta$*USD Broad* is not statistically significant, meaning that mutual funds flows of shorter maturity bonds are not statistically associated with fluctuations in the dollar exchange rate.

Taken together, these results highlight a novel message and a 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 yield changes due to the greater duration risk for the lender. Specifically, mutual funds flows 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.

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.

In Table 7 presented in the Appendix, we delve deeper into all sectors and compute the flows of each investor type within each country depending on the maturity of the bonds. Results confirm that longer maturity bonds held by mutual fund flows are the ones that are associated with the highest fluctuations to dollar exchange rate changes.

Table 2: **Investor Type Analysis: Quantification of Maturity Risk.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds denominated in local currency with remaining maturities greater than five years (column 1) or lower than five years (column 2). The analysis is restricted to the mutual fund sector. USD Broad is the annual percentage change in the Broad US dollar index. The sample period is 2004-2021. Driscoll-Kraay robust standard errors are reported in parenthesis. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

| | (1) | (2) |
|---|---|---|
| Dependent Variable | Maturity $>$ 5 years | Maturity $<$ 5 years |
| Sector | Mutual Funds | Mutual Funds |
| $\Delta$USD Broad | -2.8101*** | -1.0766 |
| | [0.9531] | [1.0211] |
| Constant | 0.2832*** | 0.2202* |
| | [0.0905] | [0.1236] |
| Observations | 256 | 249 |
| Country FE | ✓ | ✓ |

## 3.2 Additional global factors

Our main analysis has the broad US dollar index as the global factor capturing the changes in investment portfolio allocations of global investors. 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. The previous results are consistent with the broad US dollar acting as an indicator for global risk appetite. The broad US dollar index is taken from the BIS statistics and comprises sixty economies.

To alleviate endogeneity between the dollar exchange rate and investment flows, columns 1 and 2 of Table 3 replicate the analysis by using the broad US dollar for advanced economies (from the FED FRED, available since 2016). The coefficient of *Mutual*$\Delta$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 3,

Table 3: **Investor Type Analysis: Bilateral exchange rate, VIX and US monetary policy** 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 2004-2021. 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. All specifications include country-investor type fixed effects and Driscoll-Kraay standard errors. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| X Variable | ΔUSD Broad Adv Econ | | ΔBilateral ER | | ΔVIX | US rate |
| X | -0.0153 | | -0.6966** | -0.0461 | -0.0065 | 3.7680 |
| | [0.6755] | | [0.3082] | [0.3831] | [0.0043] | [4.1169] |
| Mutual*X | -2.0018** | -1.9810** | -0.3902* | -0.3635* | 0.0092 | -1.2124 |
| | [0.7066] | [0.7098] | [0.1947] | [0.2000] | [0.0062] | [3.4460] |
| Constant | 0.1625* | 0.4275*** | 0.2288** | 0.4256*** | 0.2047** | 0.1876** |
| | [0.0823] | [0.0208] | [0.0856] | [0.0198] | [0.0870] | [0.0796] |
| Observations | 914 | 914 | 1,010 | 1,010 | 1,010 | 1,010 |
| Ctry-Inv Type FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | | ✓ | | ✓ | | |
| Coefficient sum (X +Mutual*X) | -2.0171 | — | -1.0868 | -0.3782 | 0.0027 | 2.5556 |
| p-value | 0.0494 | — | 0.0027 | 0.3468 | 0.6955 | 0.4902 |

the coefficient estimate of $\Delta Bilateral$ is negative and statistically significant for the sample of investors excluding the mutual funds. When looking at the mutual funds sector, the total estimated coefficient of $\Delta Bilateral$ is -1.08 and statistically significant, which confirms that mutual funds have a procyclical behavior to country-specific exchange rate changes. However, the estimated coefficient of $\Delta Bilateral$ for the mutual fund sector is more than half of the estimated coefficient of $\Delta USD\ Broad$ (-2.57, column 2 of Table 1). Furthermore, when adding year fixed effects, the total estimated coefficient for the mutual fund sector is no longer significant (-0.3782, 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 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. This result indicates that the VIX variable does not capture the channel at play behind investment flows in local currency bonds, and differently from banking flows as a function of balance sheet adjustments that are instead captured by the VIX index (Adrian and Shin, 2010). The statistically insignificance of US monetary policy or the VIX index may be due to various reasons, including endogeneity or low data frequency. In Section 4, we perform a more structural analysis at a higher data frequency that will help better understanding the concurrent roles of exchange rates, US monetary policy, and the VIX as global factors.

### 3.3 Who is buying?

The evidence in the proceeding sections shows a distinctive procyclical behavior by mutual funds. In Table 1 we also observe that the coefficient estimate of the variable *All Others* is positive and statistically significant, meaning that, following dollar appreciation, mutual fund flows on average sells local currency bonds whereas other investor types buy some of them. Pension funds seem also to have an absorbing effect (column 7, Table 1).

Looking at Figure 4, *All Others* is a component of the total holdings of government bonds by US investors, but it is significantly smaller than the local currency holdings by US mutual funds, hence the *All Others* group are not the only investors who are buying when the mutual funds sell. Furthermore, the US investor holdings of local currency bonds have been steadily decreasing since the peak in 2012. In 2021, the total US investor holdings are almost half of the total holdings in 2012. Who is absorbing such a sell-off of local currency bonds by US investors?

Figure 6 shows the scatter plot of the annual change in the ratio of central government debt securities denominated in local currency which are held by domestic investors versus US investor flows. The left hand panel shows a negative relationship between the ratio of domestic investors and all US investors flows, meaning that domestic investors buy local currency bonds when US

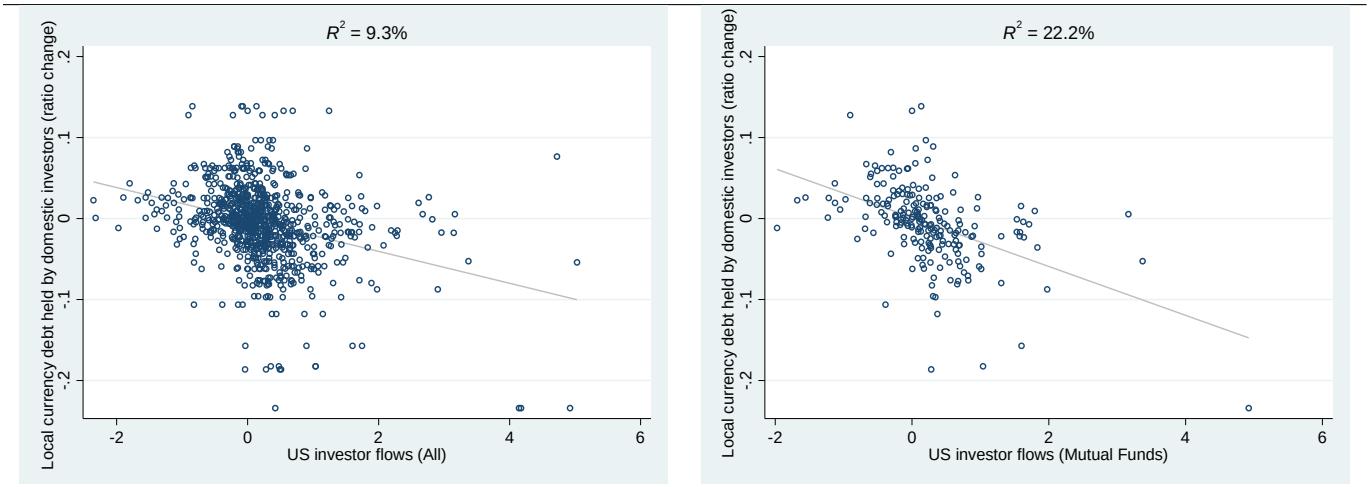


Figure 6: **US Investors versus Domestic Investors.** This figure shows the scatter plot of the annual change in the ratio of central government debt securities denominated in local currency which are held by domestic investors versus US investor flows. The domestic investor data are from Arslanalp and Tsuda, Sovereign Debt Investor Base for Emerging Markets dataset, December 2022 version.

investors sells. The linear fit reports a coefficient of -0.19 and $R^2 = 9.3\%$.The right hand panel shows that the negative relationship is even stronger for the subsample of US mutual fund flows, with a more negative slope (-0.30) and a larger $R^2 = 22.2\%$.

All in all, the scatter charts suggest that domestic investors (mostly local banks and central banks in periods of distress) absorbs some of the sell-off by US investors, especially mutual funds. Given that the ratio of domestic investors holdings is computed over the total debt in local currency held by both domestic and foreign investors, the negative relationship between US investor flows and the ratio of local currency debt held by domestic investors also implies that other foreign investors (e.g., euro area investors as in Boermans and Burger, 2023) sell concurrently when US investors sell. This may bring back risk from the lender to the borrower, 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).

## 3.4 US dollar denominated flows

The preceding analysis focuses on EM government bonds denominated in local currency. In Table 4 we consider flows of USD denominated bonds as our dependent variable, and we run a similar analysis as in Tables 1 to 2. Column 1 shows that, as it was for the case of local currency bonds, when the dollar appreciates mutual funds reduce their investments in USD currency bonds. However, the coefficient estimate of $\Delta USD\ Broad$ is -1.8, meaning that one percent appreciation in the broad dollar index is associated with a 1.8% decrease in the USD denominated notional holdings, which is about 0.7% less than the holdings denominated in local currency.

Furthermore, pension funds and insurers increase their investments following dollar appreciation. Specifically, the coefficient related to the pension funds sector (+2.3) suggets that for the dollar-denominated bonds, pension funds play a buffering role when mutual funds sell. 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 insurance sector shows a similar behavior as the coefficient estimate is 1.2 and statistically significant.

In columns 2 and 3 we observe that, differently from the case of local currency bonds, mutual funds' flows of bonds with longer maturities do not have a statistically significant association with portfolio outflows following dollar appreciation. Finally, in Table 6 reported in the Appendix, we do not observe a different behavior by mutual funds depending on High vs. Low foreign investor base or High vs. Low financial openness.

Overall, in the case of dollar denominated flows, the mutual fund sector again displays a strong sensitivity to dollar fluctuations, with pension funds and insurers playing a buffering role. This may explain why the sell-off of dollar denominated bonds is alleviated compared to local currency bonds. Investor base characteristics or the level of financial openness do not seem to play a role in explaining the higher sensitivity of the mutual fund sector. Also, longer maturities do not seem to be a source of potential vulnerability for dollar bonds in contrast to

Table 4: **US dollar denominated flows.** Column 1 of this table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds by investor type and denominated in US dollar currency. The investor types are: pension funds (Pension), insurance companies (Insur), mutual funds, and All others (depository institutions, non-financial investors, other funds, other financials). Mutual is a dummy equal to 1 that identifies the mutual fund sectors, 0 otherwise. In columns 2 and 3 the dependent variable is the annual flow of bonds denominated in USD currency for remaining maturities greater or lower than five years, respectively. USD Broad is the annual percentage change in the Broad US dollar index. All specifications include country-investor type fixed effects and Driscoll-Kraay standard errors. The sample period is 2004-2021. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

| | (1) | (2) | (3) |
|---|---|---|---|
| Dep. variable | USD | Maturity $>$ 5 yrs | Maturity $<$ 5 yrs |
| Sectors | All | Mutual | Mutual |
| Country | All | All | All |
| $\Delta$USD Broad | -1.8720** | -1.2559 | -0.9274* |
| | [0.7144] | [0.7301] | [0.5256] |
| Pension*$\Delta$USD Broad | 2.3653*** | | |
| | [0.5619] | | |
| Insur*$\Delta$USD Broad | 1.2574* | | |
| | [0.5965] | | |
| All Others*$\Delta$USD Broad | 0.4286 | | |
| | [0.4492] | | |
| Constant | 0.0538 | 0.0734* | 0.1096*** |
| | [0.0420] | [0.0407] | [0.0341] |
| Observations | 948 | 219 | 218 |
| Ctry-Inv Type FE | ✓ | ✓ | ✓ |

local currency bonds.

# 4 Dynamics of portfolio flows

The results presented in Section 3 allow us to compare the sensitivities of the mutual funds investments to fluctuations in the dollar exchange rate and across countries, controlling for factors that vary across countries or time thanks to the inclusion of country-investor type and year fixed effects. In this section we perform a complementary analysis that takes stock at a more causal interpretation of the results and delves deeper into the interactions between interest rates, exchange rates, and portfolio flows. We utilize the monthly TIC portfolio data in Bertaut and Judson (2014, 2022) to examine the time series properties of portfolio flows, especially the relationship between portfolio flows, exchange rates, and spreads.

Figure 7 shows the monthly fluctuations (in blue) of the net purchases (sales) of government bonds (USD million) together with the percentage change in the broad US dollar index (in green) for Thailand and Malaysia. From the annual TIC survey data, we know that US investment flows into Thai government bonds are into local currency-denominated bonds over the period 2012-2021, and flows into Malaysian government bonds are between 97% and 100% denominated in local currency (Figure 17).

In Fugure 7 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 for our sample of 16 EMEs at the monthly frequency and for the period from January 2012 to December 2021. 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). We impose a Cholesky ordering, with the interpretation that a variable that is higher in the ordering having contemporaneous influence in subsequent variables, whereas variables that are lower in the ordering affect previous variables with a lag.

Our empirical approach is to start with a 3-variables panel benchmark VAR model contain-


Figure 7: **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 Broad US dollar Index (right vertical axis, green line) for Thailand (left panel) and Malaysia (right panel).

ing the following three variables of interest: US investment flows in government bonds, dollar exchange rate, and local currency interest rates spreads. We then augment the benchmark specification to take into consideration other global variables like US monetary policy or volatility.

The recursive order of the benchmark specification is as follows: US investment flows in government bonds of each country, the percentage change of the broad US dollar index, and country-specific local currency government bond spreads (in first difference). This means US investment flows can have contemporaneous and lagged effects on exchange rate and local spreads; that the broad US dollar (the global factor) can have contemporaneous and lagged effects on local spreads (the local factor), but affect US investment flows only with a lag; and that local spreads can affect US investment flows and exchange rates only with a lag.

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.

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). 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 3. We then express the monthly bond flows as a share of the prior month's holdings in our analysis. We are able to construct our monthly measures of bond flows for the period 2012-2021.[6]

The local currency spread is the spread between the 5-year local currency government bond yield and the 5-year US Treasury yield as defined by Hofmann, Shim, and Shin (2020). 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. Table 5 provides summary statistics for the period from 2014 to 2021.

[6]Our sample period starts in 2012 because it is the starting year of the Bertaut and Judson (2014, 2022) methodology. When we apply the Bertaut-Tryon (2007) methodology to estimate the flows between the period 2004-2011 and re-run the panel VAR regressions, we find that the effect of dollar appreciation on the flows is negative but not statistically significant. There are several reasons for this. First, the role of the US dollar as a barometer of global financial conditions becomes preeminent after the global financial crisis, i.e., where financial intermediation starts migrating from financial intermediaries to the non-financial sector. Second, the Bertaut-Tryon (2007) monthly flow estimates come with many large outlier observations, mostly due to local currency holdings that are not sizable in a few countries and which create instability in the VAR estimations.

Table 5: **Summary Statistics.** This table shows summary statistics for the sample of sixteen EMEs (All countries), split between countries where US investment in government bonds are largely denominated in local currency (High local currency countries) and countries with large investments in US dollar denominated bonds (Low local currency countries). Portfolio flows are monthly net sales or purchases in EMEs government bonds (in percentages). Broad US dollar index is the percentage change in the Federal Reserve Broad US dollar index. Local Spreads is the spread between the 5-year local currency government bond yield and the 5-year US Treasury yield.

| Variable | Observations | Mean | Std.Dev. | Median | p25 | p75 |
|---|---|---|---|---|---|---|
| Broad US dollar index % | 120 | 0.184 | 1.521 | -0.042 | -0.881 | 1.303 |
| All countries | | | | | | |
| Portfolio Flows % | 1,920 | 0.182 | 5.655 | -0.060 | -2.132 | 2.251 |
| Local Currency Spreads | 1,920 | 3.738 | 3.310 | 3.266 | 1.188 | 5.582 |
| High local currency countries | | | | | | |
| Portfolio Flows % | 960 | -0.043 | 5.481 | 0.103 | -2.269 | 2.381 |
| Local Spreads | 960 | 2.985 | 3.177 | 2.023 | 0.323 | 5.314 |
| Low local currency countries | | | | | | |
| Portfolio Flows % | 960 | 0.407 | 5.819 | -0.156 | -2.031 | 1.984 |
| Local Currency Spreads | 960 | 4.513 | 3.262 | 4.059 | 2.291 | 5.849 |

## 4.1 Baseline specification

Figure 8 shows the impulse response functions (IRFs) to one-unit shocks of the variables in the model, with 90% level for the confidence intervals, and for a subsample of eight countries where US investments in government bonds are largely denominated in local currency, for the period 2012-2021: Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa and Thailand (Figure 17). Differently from the analysis using annual data, we do not know 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 mostly attributable to net sales or purchases of government bonds denominated in local currency.

The middle panel reports IRFs to a one percent shock of the broad US dollar index and shows the core result of our analysis. A one percent appreciation of the dollar leads to a drop in local currency investment flows by 0.29% on average after one month (left chart) and it is also associated with a simultaneous increase in local spreads by 0.057% (5.7 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 0.44% after one month and a simultaneous increase in local spreads by 0.086%.

From the third panel, left chart, the average effect on flows coming from the US dollar seems to be stronger than from local currency spreads, likely due to countries heterogeneity. For instance, the correlation between the currency spreads and one month ahead portfolio flows is negative for Mexico and zero for Korea. 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.

We attempt to quantify the combined joint effect on flows from a concurrent dollar appreciation and increase in local currency spreads by estimating a panel regression analysis where flows at month *t+1* are regressed on the dollar exchange rate, local spreads (in first difference) and

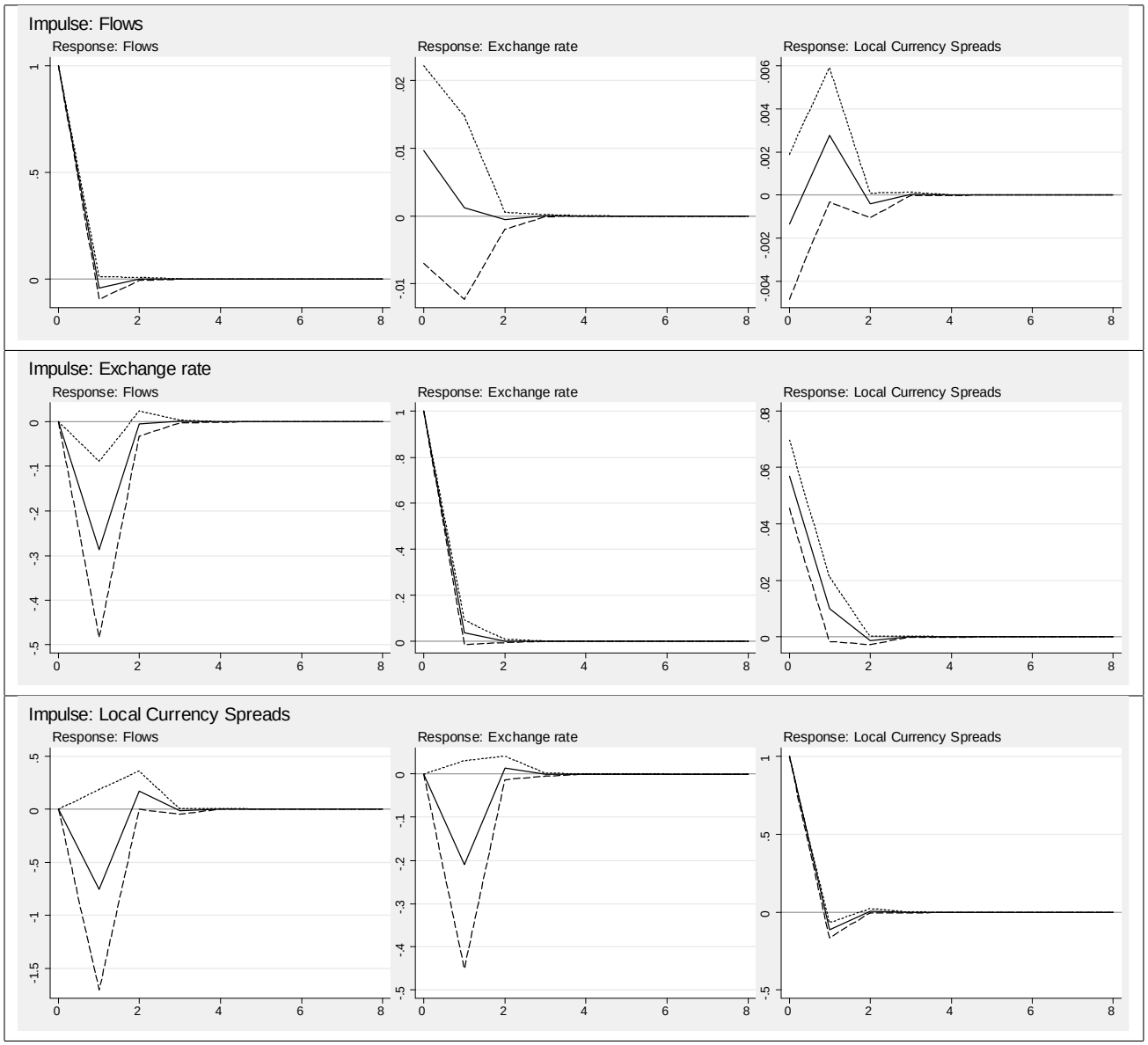


Figure 8: **Impulse response functions in recursive VAR - Sample of countries with US investments mostly in local currency bonds.** This figure presents estimated impulse-response function for the three variable recursive VAR model (US investment flows in government bonds, Broad US dollar index, and 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.

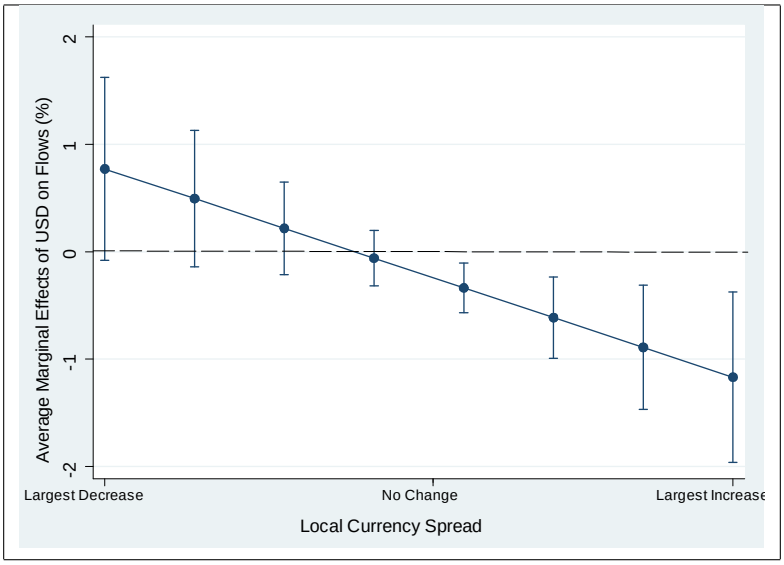


Figure 9: **The "wind chill" and "temperature" effects.** This figure presents the slope coefficients of 1 percent increase in the broad US dollar exchange rate on flows for the range of local currency spreads, from the minimum first difference value to the maximum one, for the subsample of eight countries where US investments in government bonds are largely denominated in local currency.

the interaction between the dollar and local spreads at month $t$. Figure 9 illustrates how 1% increase in the dollar exchange rate is associated with flows (i.e., the slope) for different values of local spreads, with 90% confidence intervals, for the for the subsample of eight countries where US investments in government bonds are largely denominated in local currency. The horizontal axis of Figure 9 indicates the change in local spreads, from the largest negative change (i.e., the largest decrease in spreads) to the largest positive change (i.e., the largest increase in spreads).

In the presence of both dollar appreciation and a positive increase in local currency spreads, US investors sell local currency bonds with an increasing rate as the spreads get wider. In contrast, when local currency spreads narrow, the association with flows is no longer statistically significant because exchange rates and spreads are pulling into opposite directions: as dollar appreciation is generating a negative valuation effect on flows, a reduction in spreads is increasing bond valuation.

Taken together, the evidence from the middle panel of Figure 8 and from Figure 9 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). As exchange rates and spreads are pulling in the same direction, the effect on flows will be amplified. This is the "wind chill" effect on top the temperature. This 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.

## 4.2 Duration risk

A key result from the analysis using annual data (Table 2) is related to the negative association between dollar appreciation and local currency flows of bonds with longer maturities. Here we show a complementarity analysis in a panel VAR at a monthly frequency that confirms how duration risk is reflected in the flows. Because we do not know the exact currency denomination of the holdings, we again limit our analysis to those countries where US investments are largely denominated in local currency.

Figure 10 (Panel A) shows the impulse response functions (IRFs) to one-unit shocks of the broad US dollar index on bond flows with remaining maturity greater than 5 years (i.e., the median remaining maturity across the sample of countries). Consistently with the annual data, a 1% dollar appreciation leads to a statistically significant decline in local currency flows by 0.31% after one month. Instead, in Panel B of Figure 10 we see that a 1% dollar appreciation

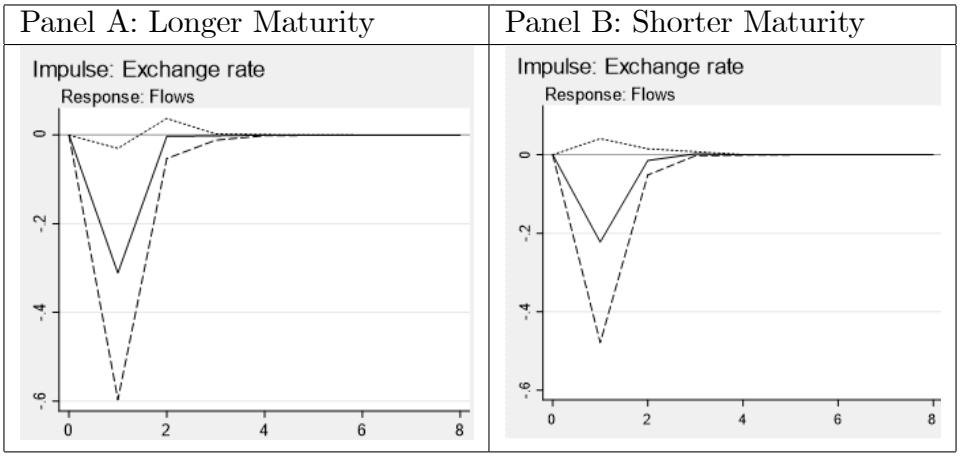


Figure 10: **Impulse response functions in recursive VAR - Duration Risk.** This figure presents estimated impulse-response function from one-unit shock of the Broad US dollar index on flows, and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, Thailand. Panel A (Panel B) estimates are for bonds' remaining maturities greater (lower) than five years.

is not statistically associated with a decline in investment flows with remaining maturities less than 5 years, which is also consistent with the evidence using annual data.

## 4.3 Additional factors

We now turn to exploring some additional factors that may be associated or directly cause fluctuations in investment flows and exchange rates. Eichenbaum and Evans (1995) found that a contractional shock to US monetary policy leads to persistent appreciation in the US dollar both in nominal and real terms. Bekaert, Hoerova, and Lo Duca (2013) show that a cut in the Fed Funds rate is followed by a dampening of the VIX index. 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 and the VIX as global factors that affects US investors' decisions also outside the United States. As before, the sample is restricted to the eight countries with high US investment holdings in local currency government bonds.

### 4.3.1 US monetary policy

Figure 11 shows the impulse-response functions with 90% level for the confidence intervals from a four-variables VAR ordered as follows: US monetary policy, US investment flows in government bonds, dollar exchange rate, and local currency spreads. To limit endogeneity concerns between US monetary policy shocks and local currency spreads that are computed using the five year US Treasury yields, we use the surprises in the 3 month US Treasury rates (Jarocinski and Karadi, 2020) as the US monetary policy variable.

The third chart of the top panel of Figure 11 shows that the broad US dollar index appreciates immediately following a US monetary policy shock. The third panel of Figure 11, second chart from the left, reveals related aspects of the mechanism at play: a one percent appreciation of the US dollar leads to about a 0.3% drop in the investment flows one month later.

Thus, the conjunction of the third chart in the top panel and of the second chart in the third panel of Figure 11 tells 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. Taken together, this result confirms the impact of exchange rates on investments decisions even after controlling for monetary policy shocks.

### 4.3.2 VIX Index

We then consider the VIX as an alternative global factor that may shift US investors' allocations away from emerging markets. The top panel of Figure 12 reports IRFs to one point increase in the VIX. We see that US flows decrease by 0.08% after one month (second chart), the broad US dollar appreciates at t=0 by 0.14% (third chart), and local currency spreads increase at t=0 by 0.013% (fourth chart). The third panel of Figure 12 shows that a one percent appreciation in the broad US dollar index has a further negative effect on US flows at t=1 by 0.25% (second chart). This means that the US dollar largely *amplifies* the negative effect on flows deriving from a shock on the VIX, and confirming the importance of the exchange rate channel for US investors of local currency bonds.

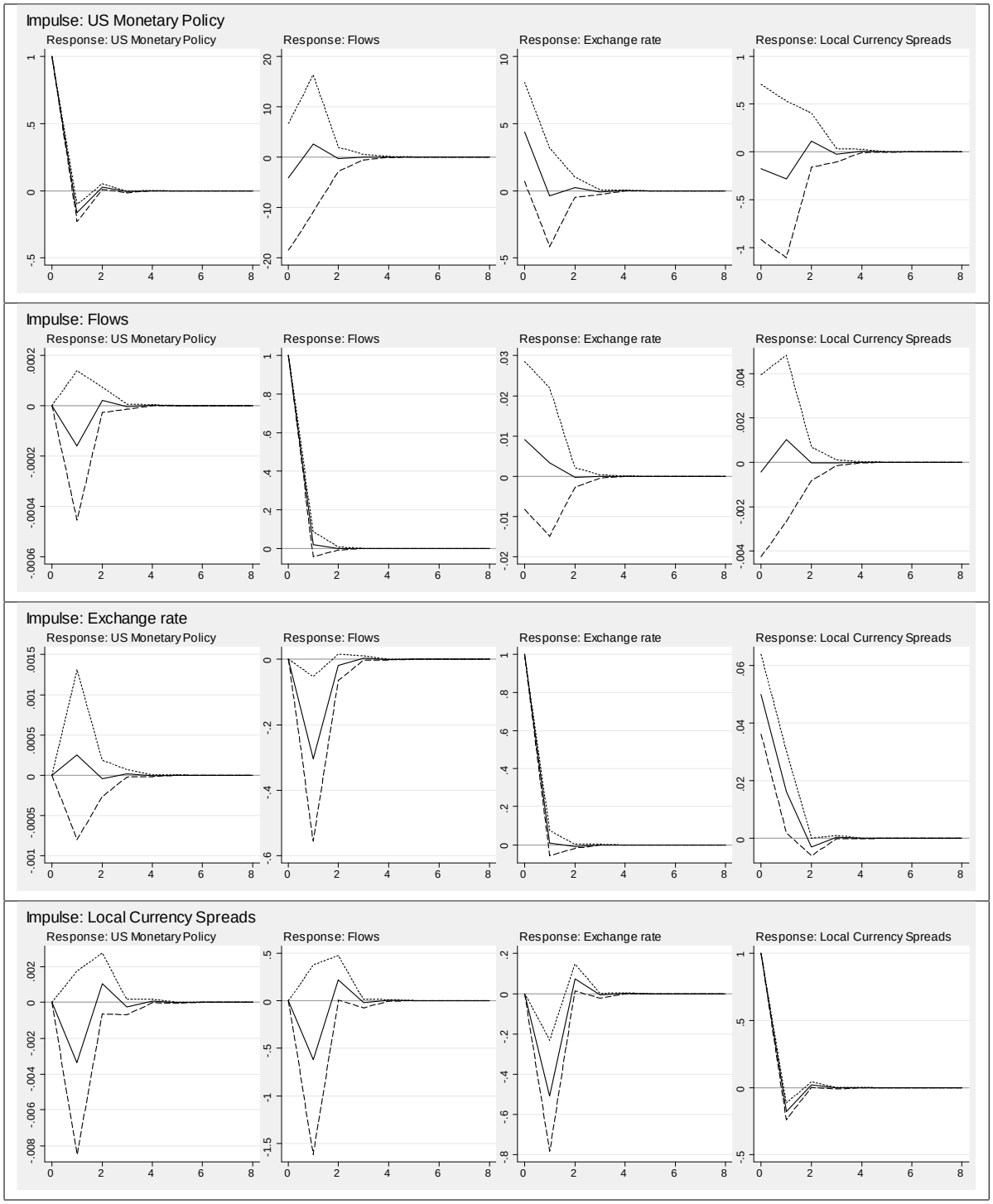


Figure 11: **Impulse response functions in recursive VAR - US Monetary policy.** This figure presents estimated impulse-response function for the four variable recursive VAR (US monetary policy, US investment flows in government bonds, Broad US dollar index, and local currency spreads) and 90 percent 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), available until June 2019.

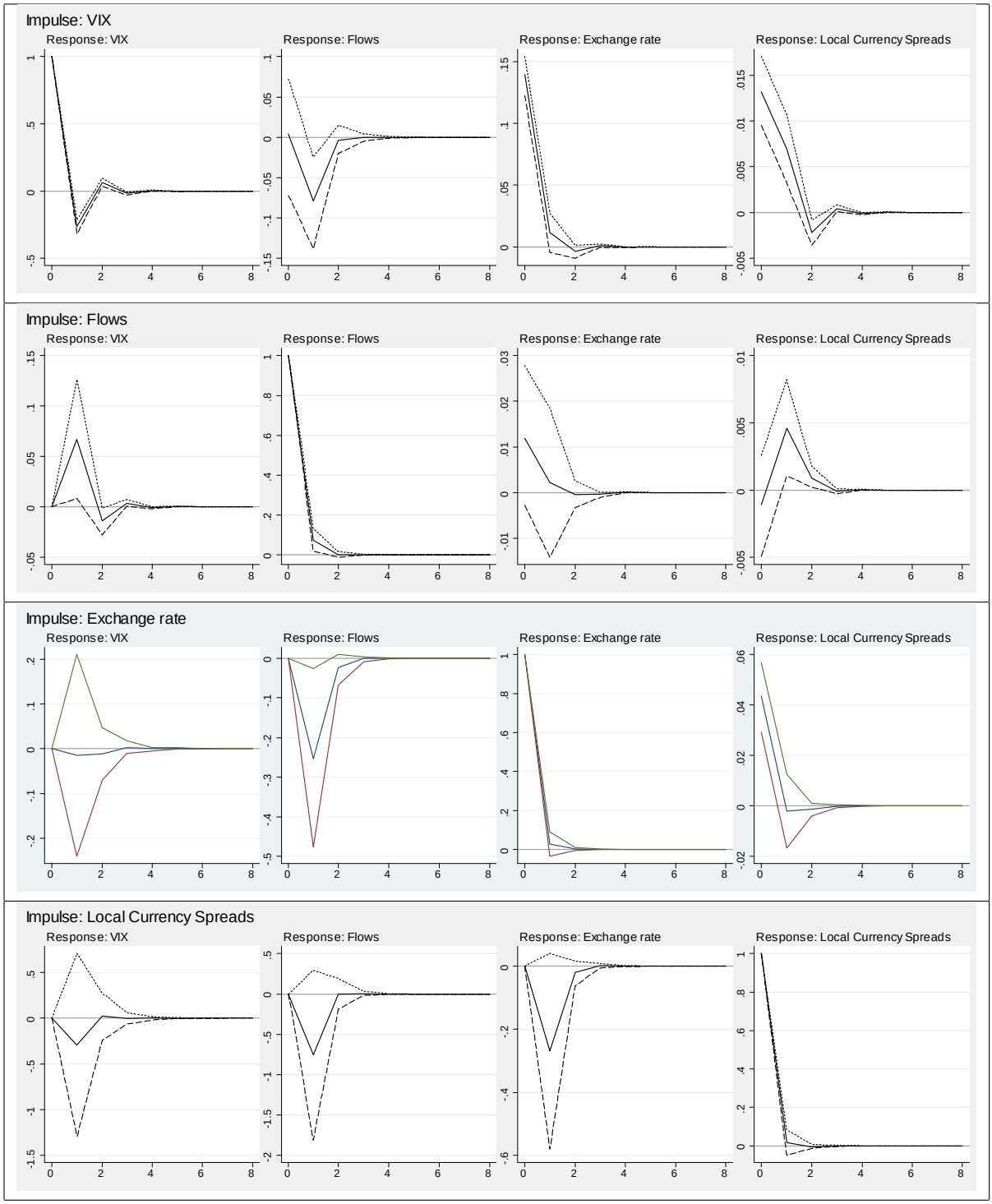


Figure 12: **Impulse response functions in recursive VAR - The VIX Index.** This figure presents estimated impulse-response function for the four variable recursive VAR (VIX, US investment flows in government bonds, Broad US dollar index , and local currency spreads) and 90 percent confidence intervals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

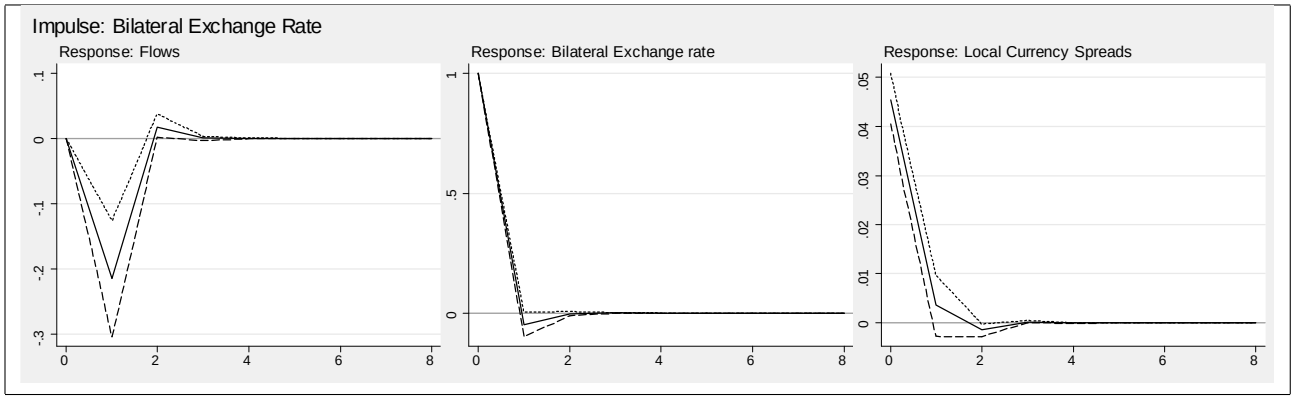


Figure 13: **Impulse response functions in recursive VAR - Bilateral Exchange Rate.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, bilateral exchange rate vis-a-vis the US dollar, and local currency spreads) and 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.

### 4.3.3 Bilateral exchange rate

The preceding analysis uses the broad US dollar index as the reference exchange rate. There are at least two reasons for using the broad dollar index. First, the broad dollar index alleviates potential issues related to endogeneity among our variables of interest. Second, Bruno and Shin (2015a, 2015b) show theoretically and empirically that under a portfolio approach, a broad based appreciation or depreciation of the dollar affects the lender's global portfolio, thus potentially setting off a feedback loop on the lenders' financial constraints that go beyond shocks in a specific country.

We replicate the benchmark specification by using the bilateral exchange rate vis-a-vis the dollar in lieu of the broad dollar index. Figure 13 shows the IRFs to a one percent appreciation of the bilateral exchange rate. The left chart shows that US investment flows decline by 0.21% after one month, consistently with the evidence on the broad US dollar index.

## 4.4 Sample of countries

The Appendix shows IRFs of the 3-variable benchmark specification for the sample of all sixteen countries and for the subsample of countries where US investments are both in local and USD currency bonds. Figure 15 shows qualitatively similar results for the entire sample of countries, although the magnitude of the dollar effect on bond flows is smaller due to the inclusion of countries also with large investments in US dollar denominated bonds.

In fact, the effect of an exchange rate shock on investment flows becomes statistically insignificant when we limit the analysis to the subsample of countries with large investments in US dollar denominated bonds (Figure 16). This is consistent with the evidence in Table 4 using annual data. US mutual funds, pension funds and insurance are the three largest US holders of US dollar denominated bonds. Following dollar appreciation, mutual funds' portfolio holdings go in the opposite direction to those of the pension funds' and insurance holdings. The upshot is that, when observing the aggregate flows, the effect of the exchange rate shock on investment flows becomes on average statistically insignificant.

Whilst we do not observe a statistically significant direct effect from the exchange rate on flows, instead we see an impact through local currency spreads: dollar appreciation is associated with a concurrent increase in local currency spreads (third chart, second panel of Figure 16), which in turn leads to a decrease in investment flows in the following period (first chart, third panel of Figure 16).

## 4.5 Dollar betas

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 14, 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

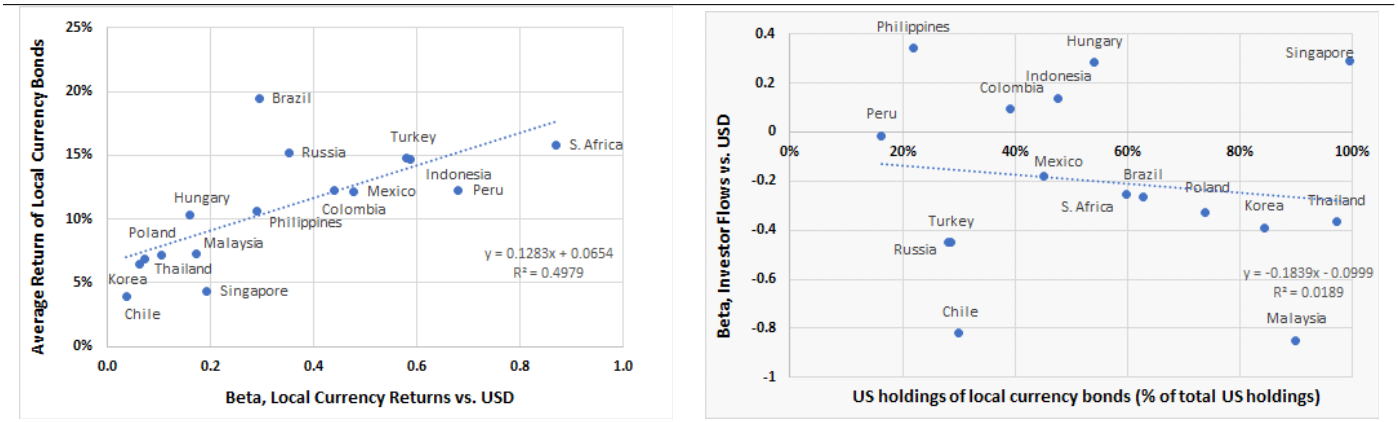


Figure 14: **Dollar Betas.** The left-hand panel of this figure shows the scatter plot of the dollar beta local returns in the horizontal axis and the average return of local currency bonds in the vertical axis. The right-hand panel of this figure shows the ratio of US total investment holdings in local currency bonds in the horizontal axis and the dollar beta investor flows in the vertical axis.

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 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.

Figure 14, right-hand panel, plots on the horizontal axis the ratio of US total investment holdings in local currency bonds to total US investment holdings (local + dollar denominated). 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, and after removing it the slope coefficient becomes more negative (-0.48).

# 5 Concluding remarks

Our paper has examined the relationship between portfolio 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. Duration risk plays a central role. Emerging market governments have largely overcome Original Sin by issuing debt in local currency at increasingly long maturities. However, duration risk can interact with currency risk to amplify portfolio flows.

Mutual funds display a heightened sensitivity of portfolio flows to duration risk and exchange rate changes. However, 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.

Our findings highlight 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. For this purpose, dollar-denominated bonds may be better-suited than EME local currency bonds, as the former are free of currency risk. Insurers tend to be buy-and-hold investors and their portfolio holdings tend to be much stickier than for mutual funds. Pension funds show a similar behavior. This is consistent with the evidence found in Ng, Shim, and Vidal Pastor (2019) who show that, during the Taper Tantrum period, mutual funds were subject to outflow pressures and liquidated their bond holdings of emerging Asian bond markets, while insurance companies, annuities and pension funds bought additional bonds in these markets. Hence, paradoxically, EM governments that have issued dollar-denominated bonds may benefit from more stable funding due to a "stickier" investor base.

Our results 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 sensi-

tivity of flows to shifting financial conditions. 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.

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# A Appendix

## A.1 Country characteristics and amplification effects

Having established in Table 1 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 6 we look at possible country characteristics that accentuate such procyclical behavior.

We construct the dummy variable *Mutual* that is equal to one for the mutual funds sector, and zero otherwise, interacted with $\Delta$*USD Broad*. The reference group consists of all the other investor types (pension funds, insurance sector, and all others aggregated) for the period 2004-2021. This allows us to run a specification that includes both country-investor type and year fixed effects. Panel A is for bond flows denominated in local currency, whereas Panel B is for bond flows denominated in US Dollar.

In columns 1 and 2, we look the percentage of government debt securities denominated in local currency held by foreigners as given by the 2022 IMF Sovereign Debt Investor Base for Emerging Markets, available for the period 2004-2021 and for all countries except South Korea and Singapore. In each year we construct the median value of the percentage of government debt securities denominated in local currency held by foreigners, and then split the sample of countries between High (Low) foreign investor base if the country percentage is above (below) the overall median percentage value.

In column 1 of Table 6 the coefficient estimate *Mutual**$\Delta$*USD Broad* is -2.26, meaning that, for the subsample of countries with a large presence of foreign investors, a one percent appreciation in the broad US dollar index is associated with a 2.26 percent larger decline in local denominated holdings by mutual funds than other investors on average. In contrast, in column 2 we do not observe a significant procyclical behavior in those countries where the foreign investor base is smaller. These results should be interpreted with the usual caveat that the degree of foreign investor presence is an endogenous decision. Yet, the evidence suggests that a strong local investor base may be able to mitigate the procyclicality of dollar fluctuations.

Table 6: **Investor Type Analysis: Investors Base and Financial Openness.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds by investor type and denominated in local currency (columns 1 to 4) or in US dollar currency (columns 5 to 8). Mutual is a dummy equal to 1 that identifies the mutual fund sector, 0 otherwise. USD Broad is the annual percentage change in the Broad US dollar index. The sample period is 2004-2021. All specifications include year fixed effects and country-investor type fixed effects. Driscoll-Kraay robust standard errors are reported in parenthesis. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

| Panel A | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dep. variable | | Local, All Sectors | | |
| Country | High foreign inv base | Low foreign inv base | High fin openness | Low fin openness |
| Mutual* | -2.2677** | -1.2360 | -2.4351* | -0.5798 |
| *$\Delta$USD Broad | [0.9238] | [0.9981] | [1.2049] | [1.0896] |
| Constant | 0.7156*** | 0.7061*** | 0.8925*** | 0.2158*** |
| | [0.0624] | [0.0409] | [0.0533] | [0.0214] |
| Observations | 437 | 409 | 533 | 477 |

| Panel B | (5) | (6) | (7) | (8) |
|---|---|---|---|---|
| Dep. variable | | USD, All Sectors | | |
| Country | High foreign inv base | Low foreign inv base | High fin openness | Low fin openness |
| Mutual* | -1.2823** | -1.4871*** | -1.4667** | -1.3918** |
| *$\Delta$USD Broad | [0.5442] | [0.5058] | [0.6685] | [0.6128] |
| Constant | 0.3906*** | -0.0220 | 0.2768*** | 0.0871*** |
| | [0.0137] | [0.0270] | [0.0165] | [0.0103] |
| Observations | 472 | 408 | 497 | 451 |

Finally, in columns 3 and 4 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.

All in all, these results highlight the procyclical response of mutual funds to dollar appreciation especially where foreign investors are major holders of sovereign debt and in countries with greater financial openness.

Finally, in columns 5 to 8 we replicate the exercise by using investor flows denominated in US dollar. In columns 5 and 6, we look the percentage of total government debt securities denominated held by foreigners as given by the 2022 IMF Sovereign Debt Investor Base for Emerging Markets, available for the period 2004-2021 and for all countries except South Korea and Singapore. We do no look at the percentage of government debt securities denominated in foreign currency held by foreigners because such a ratio is close to 100%. In each year we construct the median value of the percentage of total government debt securities held by foreigners, and then split the sample of countries between High (Low) foreign investor base if the country percentage is above (below) the overall median percentage value. High vs. Low financial openness is as computed for the case of local currency bonds.

Differently from the case of local currency bonds, here we do not observe a different behavior by mutual funds depending on High vs. Low foreign investor base (columns 5 and 6) or High vs. Low financial openness (columns 7 and 8).

## A.2 Duration risk and amplification effects: All sectors

In this empirical exercise, we define long vs. short maturity of US investor holdings according to the median value within the same country. This methodological approach allows to maximize the sample size especially in those countries or investor-type sectors where US investor holdings are small in size. By doing so, we are able to have a more balanced measure of flows across

countries, however the estimated coefficient captures a benchmarked maturity that differs across countries.

Specifically, we calculate the remaining maturity per bond and then split the holdings into two buckets: those with remaining maturity that is longer than the weighted median remaining maturity by country/currency/year, and those with shorter remaining maturity. In this way, we are able to analyze the behavior of the same investor type within the same country in a specific year and depending on the maturity (short or long) of the bonds he/she is holding.

Columns 1 to 4 of Table 7 shows results where the dependent variable is the flows of local currency-denominated emerging market government bond with longer remaining maturities, by investor type-country. As before, the specification is for the period 2004-2021, it includes country-investor type fixed effects and Driscoll-Kraay standard errors, and outliers are excluded at the 0.5 percentile level.

In column 1 the investor flows are regressed on the percentage change in the broad US dollar index. We see that the coefficient of $\Delta USD\ Broad$ is negative but not statistically significant, indicating that on average investor flows of longer-maturity bonds do not seem to respond to shifts in the dollar at the annual frequency.

However, when we focus on the holder type, we see that, once again, it is the mutual fund sector that shows a particularly strong relationship to the fluctuations in the dollar. In column 2, when we limit the sample to mutual funds only, the coefficient estimate of $\Delta USD\ Broad$ is negative and statistically significant at the 10% level. A one percent appreciation in the broad dollar index is associated with a 2.3% decrease in the flows of longer maturity bonds.

In column 3 we examine each US investor type by interacting the broad US dollar index in sequence with a number of dummy variables (one for each investor type). The dummy variable takes value 1 for a specific investor type, and 0 otherwise. As in Table 1, the default sector is the mutual fund sector, so that the size of the coefficients reflect the difference of each sector from the mutual fund sector.

The coefficient for $\Delta USD\ Broad$ for the mutual fund sector is negative and statistically significant, whereas for all other US investor types the aggregate effect (estimated by the sum

of $\Delta$*USD Broad* and the respective interaction term) is not statistically significant at the annual frequency. Interestingly, the coefficient estimate of *Insur**$\Delta$*USD Broad* is positive and statistically significant, indicating that the insurance sector is buying longer-maturity bonds when mutual funds sell, but the economic importance of these purchases is small, as overall, the insurance sector holds relatively few local-currency government bonds of the countries in our sample.

In column 4 we use a dummy equal to one for the mutual funds sector, and zero otherwise, interacted with $\Delta$*USD Broad,* in a specification that includes both country-investor type and year fixed effects. The interaction term *Mutual**$\Delta$*USD Broad* is negative and statistically significant, confirming that the mutual fund sector is the sector that sells off long-term bonds when the dollar appreciates.

Columns 5 to 8 of Table 7 look at shorter maturity bonds. Here the dependent variable is the flows of local currency-denominated emerging market government bond with shorter remaining maturities, by investor type/country. One again, the mutual funds are the sector that shows a procyclical behavior to dollar fluctuations even in the case of shorter maturities. However, the economic magnitude is smaller than for longer maturities, as a one percent appreciation in the broad dollar index is associated with a 1.6 % decrease in the flows of shorter maturity bonds (column 6), which is about 0.7% lower than in the case of longer maturities bonds. Furthermore, when controlling for time fixed effects, mutual funds no longer respond to fluctuations in the dollar as the coefficient of the interaction term *Mutual**$\Delta$*USD Broad* becomes statistically insignificant (column 8).

## A.3 Dynamics of portfolio flows: All countries

Figure 15 shows the impulse response functions (IRFs) of the 3-variables panel benchmark VAR model (US investment flows in government bonds, broad US dollar index, and local currency spreads) to one-unit shocks of the variables in the model, with 90% level for the confidence intervals, and for the entire sample of countries (Brazil, Chile, Colombia, Hungary, Indonesia, South Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Singapore, South Africa,

Table 7: **Investor Type Analysis: Maturity and Amplification Effects.** This table shows panel regressions where the dependent variable is the annual flow of emerging market government bonds denominated in local currency and with longer (columns 1 to 4) and shorter (columns 5 to 8) remaining maturities. Mutual is a dummy equal to 1 that identifies the mutual fund sector, 0 otherwise. Pension is a dummy equal to 1 that identifies the pension fund sector. Insur is a dummy equal to 1 that identifies the insurance companies. All other is a dummy equal to 1 that identifies all other sectors (depository institutions, non-financial investors, other funds, other financials). USD Broad is the annual percentage change in the Broad US dollar index. The sample period is 2004-2021. Driscoll-Kraay robust standard errors are reported in parenthesis. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Dependent variable | Long | Long | Long | Long | Short | Short | Short | Short |
| Sector | All | Mutual | All | All | All | Mutual | All | All |
| Mutual*ΔUSD Broad | | | | -1.8537* | | | | -0.5145 |
| | | | | [1.0510] | | | | [0.8985] |
| ΔUSD Broad | -0.8359 | -2.3455* | -2.3455* | | -1.2869 | -1.6089*** | -1.6089*** | |
| | [0.9981] | [1.2681] | [1.2682] | | [0.8027] | [0.5268] | [0.5268] | |
| Pension*ΔUSD Broad | | | 1.9316 | | | | 0.0253 | |
| | | | [1.1955] | | | | [1.1222] | |
| Insur*ΔUSD Broad | | | 3.0045** | | | | -0.9115 | |
| | | | [1.2892] | | | | [2.0132] | |
| All Others*ΔUSD Broad | | | 1.3532 | | | | 2.0752 | |
| | | | [1.0111] | | | | [1.5484] | |
| Constant | 0.1635** | 0.2288** | 0.1630** | 0.1672*** | 0.2574*** | 0.2294** | 0.2582*** | 0.8223*** |
| | [0.0746] | [0.0923] | [0.0744] | [0.0270] | [0.0876] | [0.1041] | [0.0883] | [0.0255] |
| Obs. | 960 | 255 | 960 | 960 | 994 | 253 | 994 | 994 |
| Ctry-Inv Type FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | | | | ✓ | | | | ✓ |

Thailand, and Turkey).

Figure 16 shows the impulse response functions (IRFs) of the 3-variables panel benchmark VAR model (US investment flows in government bonds, broad US dollar index, and local currency spreads) to one-unit shocks of the variables in the model, with 90% level for the confidence intervals, and for sample of countries with relatively lower investments in local currency bonds (Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia, and Turkey).

## A.4 US Investors holdings

Figure 17 shows the annual outstanding value of holdings by US investors and their net purchases (sales) of government bonds (USD million) for a selected sample of EMEs, for dollar-denominated bonds and in local currency. 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 17 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 somewhat after 2014. The last row of Figure 17 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 18 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 17. In fact, for countries like Peru or Philippines in the bottom row of Figure 18, US investors primarily hold government bonds

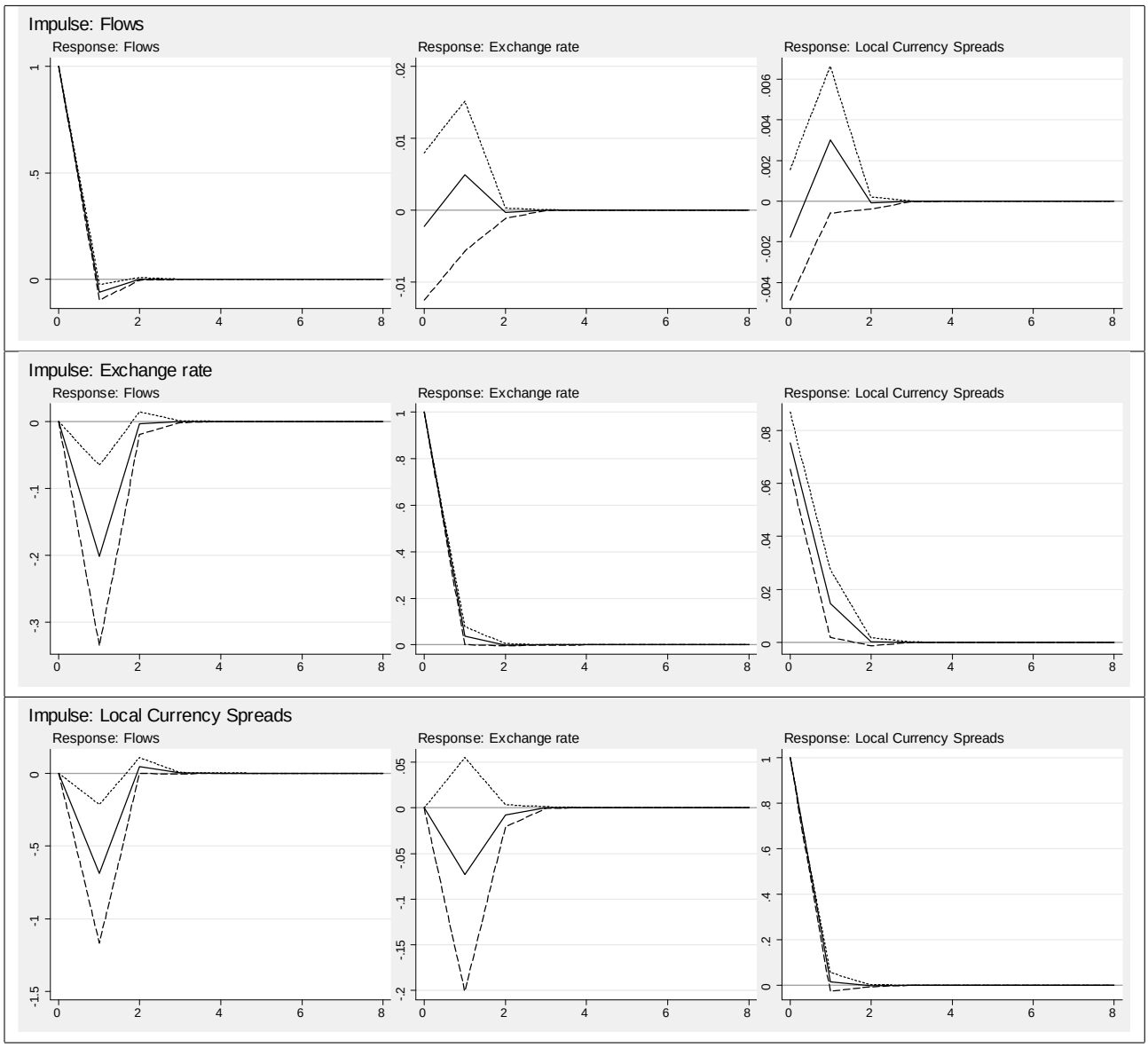


Figure 15: **Impulse response functions in recursive VAR - Sample of all 16 countries.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, Broad US dollar index, and local currency spreads) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Brazil, Chile, Colombia, Hungary, Korea, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Singapore, South Africa, Thailand, and Turkey.

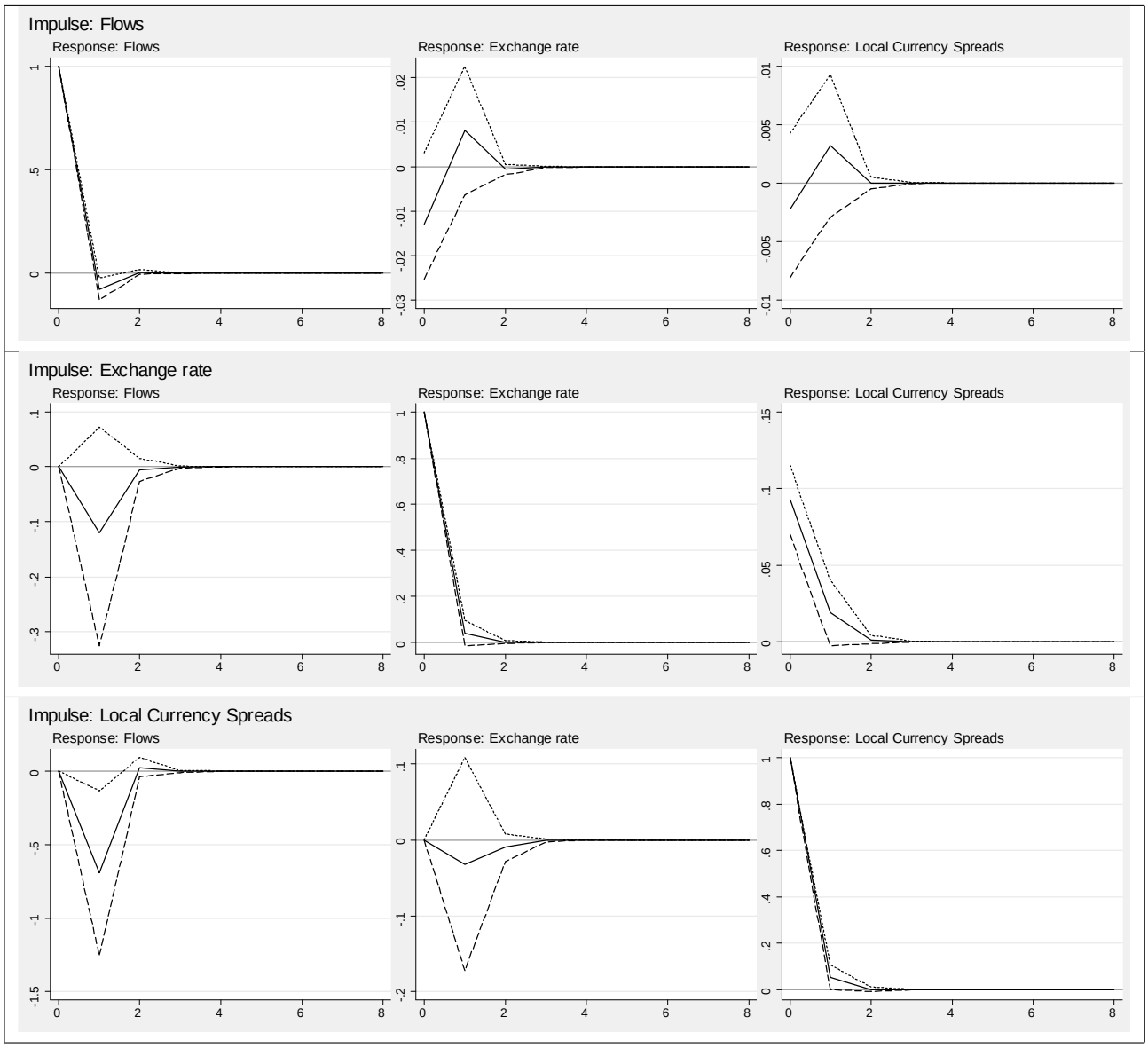


Figure 16: **Impulse response functions in recursive VAR - Sample of countries with US investments in both local and USD currency bonds.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, Broad US dollar index, and local currency spreads) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia, and Turkey.

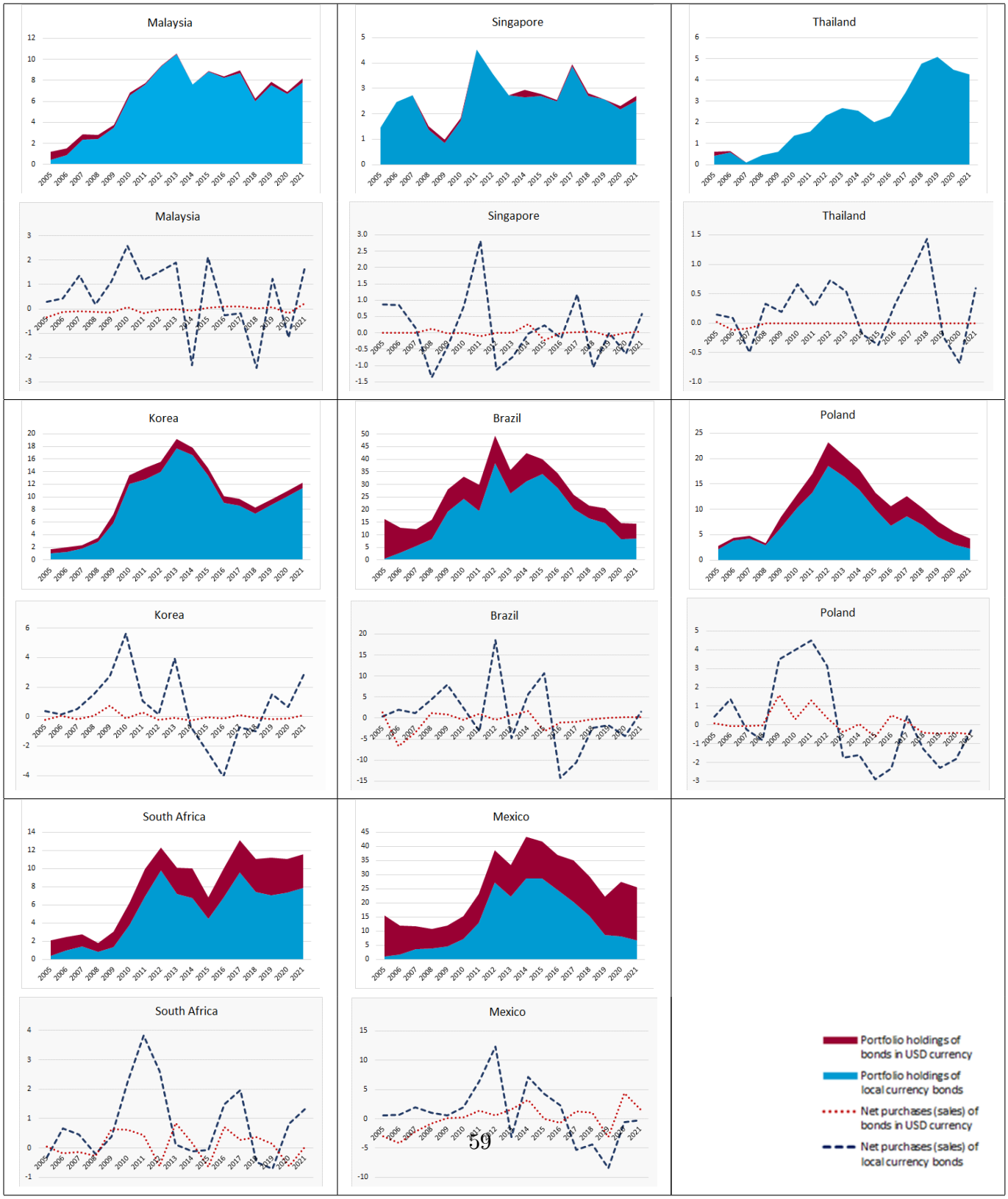


Figure 17: **High local currency holdings.** This figure shows a sample of countries where US investors mostly hold government bonds denominated in local currency. The areas capture the total value amount of holdings (USD billion). The dotted lines show net purchases (sales). Blue areas and lines indicate holdings and flows denominated in local currency. Red areas and lines indicate holdings and flows in USD denominated currency.

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 four sectors, we know the year-end holdings of government bonds of each issuer by currency of denomination starting in 2014.

The top panel of Figure 19 shows the outstanding market value (in USD billion) of government bonds denominated in local currency by each type of US investor for the period 2014-2021. Within the category "All others", comprising 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 the US investors.

The sector "Other financials", comprising of entities like broker dealers, account 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. Holdings of US other financial entities 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. In terms of volatility, non-financial institutions are the second most volatile sector after the mutual funds, with a standard deviation of 9%. "Other funds", comprising of entities like hedge funds, 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 19 (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.

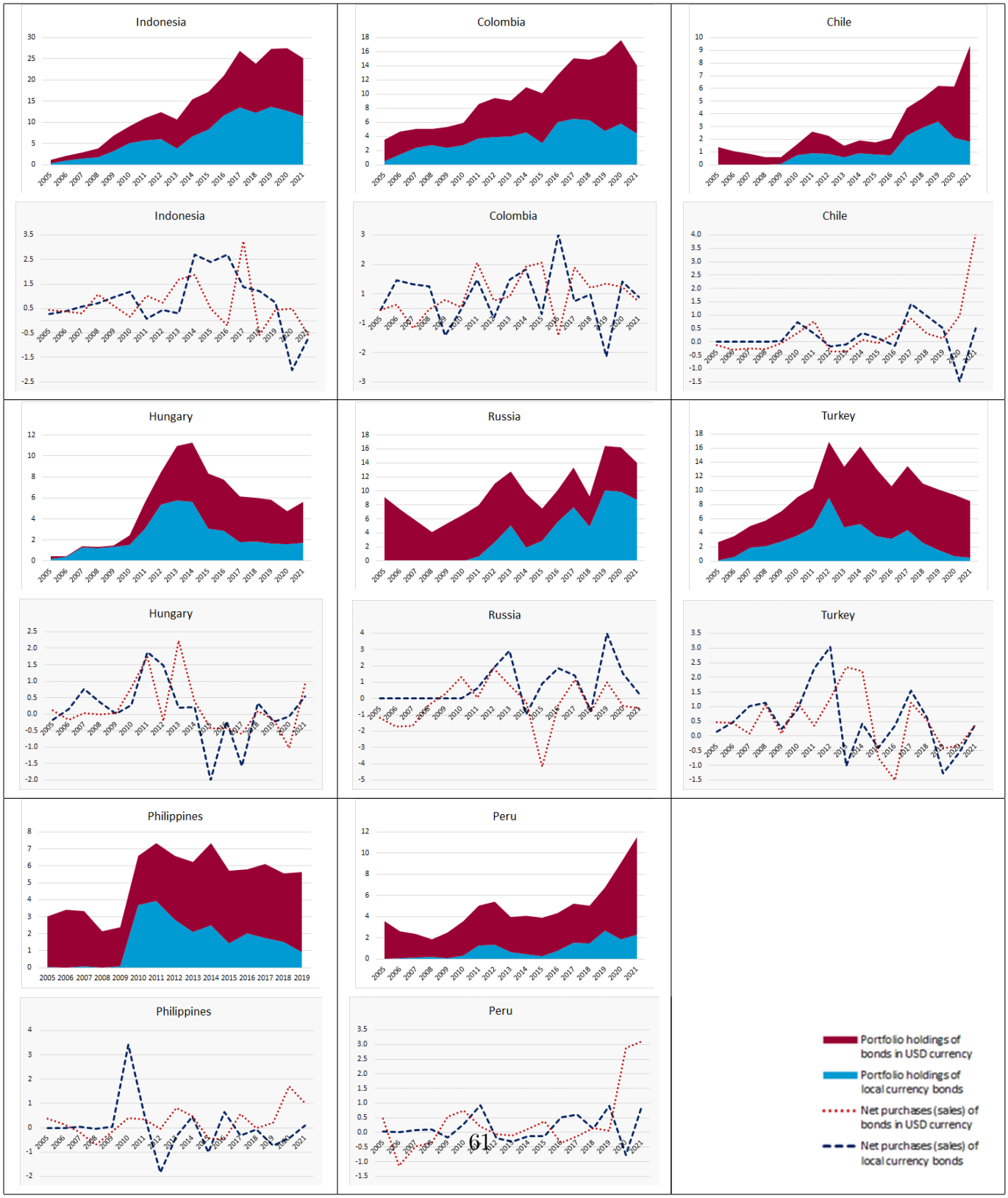


Figure 18: **Low local currency holdings.** This figure shows a sample of countries where US investors hold government bonds denominated in both USD and local currency. The areas capture the total value amount of holdings (USD billion). The dotted lines show net purchases (sales). Blue areas and lines indicate holdings and flows denominated in local currency. Red areas and lines indicate holdings and flows in USD denominated currency.

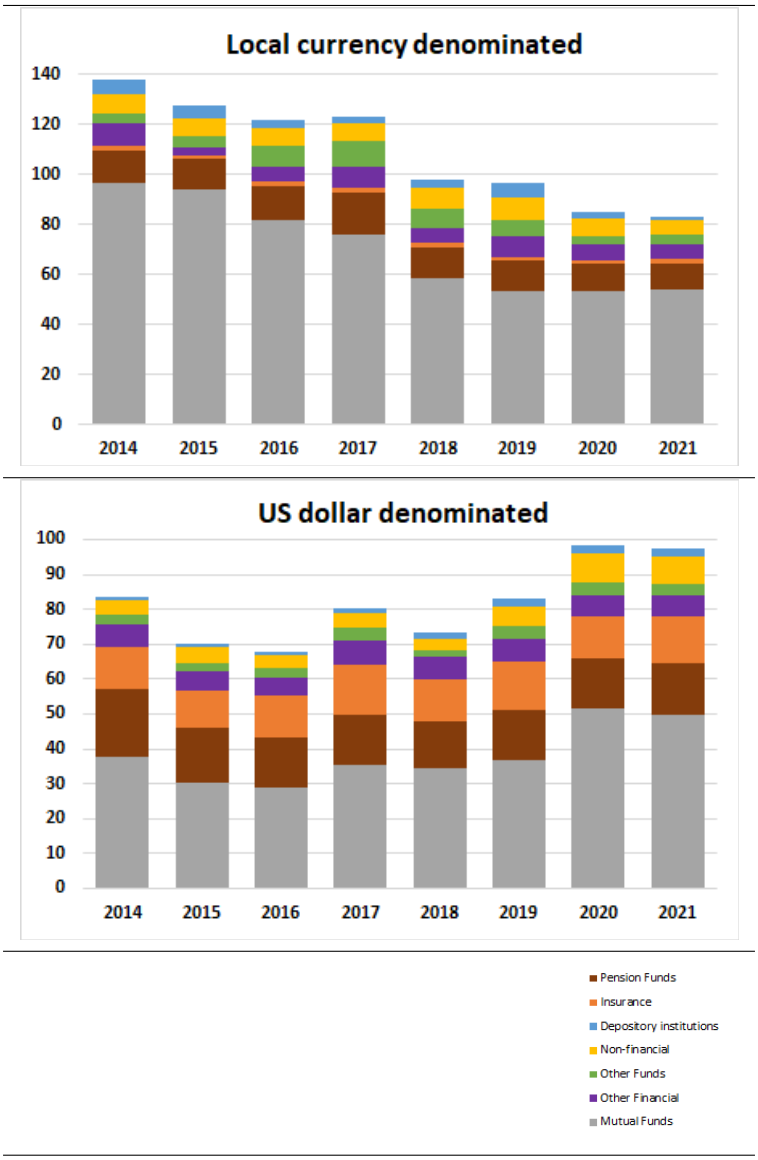


Figure 19: **Local currency and US dollar-denominated holdings by investor type.** This figure shows the holdings (USD billion) of government bonds that are denominated in local currency or US dollars for our sample of sixteen EMEs by type of investor over the period 2014-2021: Mutual Funds, Pension Funds, Other Funds, Depository Institutions, Other Financial Institutions, Non-financial institutions, and Insurance.