Original Sin Redux*

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April 5, 2021

Abstract

We explore the relationship between portfolio flows and financial conditions by using a unique and comprehensive database of US investor flows into emerging market government bonds. We find that mutual funds display a more procyclical pattern of flows relative to other investor types. Delving into the dynamics of portfolio flows at monthly frequency reveals that dollar appreciation amplifies the sell-off in EM local currency bonds, but not dollar-denominated bonds, possibly reflecting clientele effects of stickier investors toward dollar-denominated bonds. Our findings underscore how borrowing in domestic currency has not insulated emerging markets from fluctuations in global financial conditions.

*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 for excellent reseach assistance, Jimmy Shek for help with data, and Emily Liu for assistance with the historical surveys. We also thank Wenxin Du (discussant), Ilhyock Shim, and 2021 AEA participants for comments and suggestions. Corresponding author: Hyun Song Shin, Bank for International Settlements, Centralbahnplatz 2, Basel, Basel-Stadt 4002, Switzerland. Email: hyunsong.shin@bis.org

1 Introduction

Historically, 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. Currency mismatch exposed borrowers to the consequences of currency depreciation, raising borrowing costs for the borrowing government through heightened risk premia and perpetuating the reliance on foreign currency external debt.

However, since the emerging market crises of the 1990s, the share of government debt in foreign currency has fallen significantly. Domestic capital markets in emerging markets have deepened, but importantly, global portfolio investors have taken a greater share of local currency-denominated sovereign bonds. In this sense, emerging market governments have been able to overcome Original Sin and reduce their vulnerabilities associated with currency mismatch.

Nevertheless, issuing debt in local currency has not been sufficient to insulate the borrowers from the fluctuations in global financial conditions. Global portfolio investors evaluate their returns in dollar terms (or in other hard currency terms), so that exchange rate fluctuations that accompany portfolio flows amplify their gains and losses and can elicit portfolio adjustments that amplify shocks. Carstens and Shin (2019) dubbed this migration of currency risk from the borrower to the lender as "Original Sin Redux".

During tranquil periods associated with strong portfolio inflows, yields fall and the emerging market currency appreciates against the dollar. However, during periods of financial stress, portfolio outflows go hand-in-hand with rising yields and a depreciating currency (Hofmann, Shim and Shin, 2019; IMF, 2020). These empirical regularities reinforce the embedded risk premia associated with credit risk (Du and Schreger, 2016; Du, Plueger, and Schreger, 2020).

Our paper sheds light on the triangular relationship between portfolio flows, exchange rates and financial conditions by utilizing a comprehensive dataset of portfolio flows of all US investors in emerging market sovereign bonds. Our data are drawn from the well-known Treasury TIC

(Treasury International Capital) data for the United States on cross-border portfolio flows (see Bertaut, Bressler, and Curcuru (2019) for further details). 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 (Bertaut and Judson, 2014; 2015).

Our dataset presents two advantages relative to other sources used in the literature.

First, previous studies of portfolio flows have mostly focused on mutual fund flows due to data limitations on other investor types. However, 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. In contrast, the comprehensive nature of our dataset allows us to address precisely such broader macro questions. We are able to study the comparative portfolio decisions across seven investor sectors and find that, indeed, the mutual fund sector is rather special and displays properties that are different from other investor sectors. Mutual funds display a heightened sensitivity of portfolio flows to exchange rate changes and shifts in financial conditions. 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.

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 (Chernenko and Sunderam, 2016; Morris, et al., 2017; Zeng, 2017; Ma, et al., 2020, Schrimpf, et al., 2021). 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

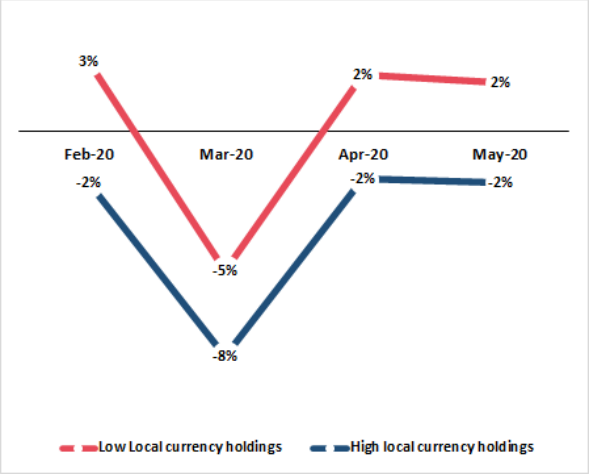

Figure 1: This figure shows the average of the net purchases (sales) of sovereign bonds (as percent of holdings) by US investors in the period from February 2020 to May 2020, for the sample of sixteen EMEs. The sample is divided between countries where US investors mostly hold government bonds denominated in local currency (High Local currency holdings) and countries where US investors also hold a significant proportion of government bonds denominated in US dollar currency (Low Local currency holdings). The 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 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 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 (BIS, 2020; FSB 2020; Falato, Goldstein and Hortacsu, 2020; Haddad, et al., 2020; Hofmann, et al. 2020; Schrimpf et al. 2021; Vissing-Jorgensen, 2020). Stresses were seen over a wide range of asset classes, including corporate bonds and Treasury markets. Emerging market sovereign bonds were not spared in the broad-based stress in financial markets experienced during this period. Portfolio outflows from emerging markets in March 2020 amounted to more than $100 billion (IMF, 2020).

Figure 1 gives a flavor of the analysis to follow, viewed through the March 2020 stress period. Figure 1 shows the average monthly net purchases of EM sovereign bonds by US investors as a percentage of holdings in 16 countries partitioned into two groups. The 16 countries are

grouped into, first, those where US investors hold government bonds mostly denominated in the *local currency of the borrower* (Brazil, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, and Thailand) and those where US investors also hold government bonds *denominated in US dollars* ("Low Local currency holdings" group, consisting of Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia, and Turkey). We see that it is the former group which saw the larger portfolio outflows in March 2020, contrary to the received wisdom that currency mismatch on the part of the borrower is the source of emerging market woes. Instead, Figure 1 is a vivid illustration of Original Sin Redux.

Our paper is structured in two parts. In the first, we examine the cross-section of seven investor types and the sensitivity of their portfolio holdings to fluctuations in financial conditions as captured by the changes in the US dollar index, which is considered as a barometer of global financial conditions (Bruno and Shin, 2015a; Avdjiev et al., 2019).

The seven investor sectors are: pension funds, insurance companies, depository institutions, non-financial investors, "other funds", "other financials" and mutual funds. In this classification, "other funds" denote collective investment vehicles that fall outside the regulated mutual funds sector (such as hedge funds), while "other financials" include financial institutions that are not captured elsewhere, most notably, the broker-dealers.

In terms of their heft, mutual funds clearly stand out as the largest holders of EME sovereign bonds, accounting for just over half of all local currency bonds held by US residents as a whole. Importantly, we observe that US mutual fund holdings of local currency bonds are more sensitive to shifts in financial conditions as measured by the sensitivity of portfolio shifts to fluctuations in the broad dollar index. Mutual funds significantly decrease their holdings when the dollar appreciates. In contrast, other investor sectors display much less 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.

The only exception to the buffering role of other investor sectors is the "other financials" sector that include the broker dealers. This "other financials" sector is small relative to the

mutual fund sector, but it turns out to be most procyclical. Their sensitivity to dollar fluctuations stands out, even relative to the mutual fund sector. The sensitivity of broker dealers could reflect their market-oriented portfolios (in contrast to banks that hold loans) as well as their higher leverage (see Adrian and Shin (2010) for a discussion of the leverage of broker-dealers).

In the second part, we delve into the dynamics of the triangular relationship between portfolio shifts, financial conditions and exchange rates. We estimate a structural panel VAR for a sample of 16 emerging market economies for the period 2012 to 2019. Our dataset allows us to disentangle the currency denomination of investment flows from underlying returns in domestic currency and thereby pinpointing the economic channels at play. 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 EME currency even as the yields fall. However, such investors "lose twice" when financial conditions turn because they have to deal with the effect of currency movements on top of the underlying local currency returns.

We find the following sets of results. In countries where US investor holdings are almost exclusively in the EM local currency-denominated bonds, a one percent appreciation of the dollar in the bilateral exchange rate leads to a drop in the notional value of local currency holdings of 0.44% after one month, showing that borrowing in domestic currency does not suffice to insulate the borrower from currency depreciation. To gain perspective, the economic magnitudes are important because the US dollar appreciated against the EM currencies in our sample on average by 0.08% per month over the sample period. In contrast, when US investors holdings are mostly denominated in US dollars, fluctuations in the bilateral exchange rate do not statistically impact investor flows. Results are robust to a battery of tests and factors that may be associated or directly cause fluctuations in investment flows and exchange rates.

We explore possible reasons for our findings, and highlight the possible clientele effect of particular investor sectors in explaining our findings. 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 are better-suited than EME local currency bonds, as the former are free of currency risk. In this respect, it makes

eminent sense for US insurers to hold dollar-denominated bonds, As insurers tend to be buy-and-hold investors, their portfolio holdings tend to be much stickier than for mutual funds.[1] Hence, paradoxically, EM governments that have issued dollar-denominated bonds may benefit from more stable funding due to a "stickier" investor base.

Our findings run counter to the presumption that emerging market woes are due mainly to EM governments borrowing in foreign currency. If anything, we find that the local currency-denominated bonds of emerging markets display greater sensitivity of flows to shifts in financial conditions. While the bilateral exchange rate comes through as a risk factor, the greater impact comes from fluctuations in the broad dollar exchange rate, suggesting that the risk-taking channel of exchange rates is an important determinant of financing conditions (Bruno and Shin, 2015a; 2015b).

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; Pandolfi and Williams, 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). 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.

[1] 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.

2 A first look at the data

Figure 2 shows 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 2 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 2 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 3 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 2. In fact, for countries like Peru or Philippines in the bottom row of Figure 3, US investors primarily hold government bonds that are denominated in US dollars.

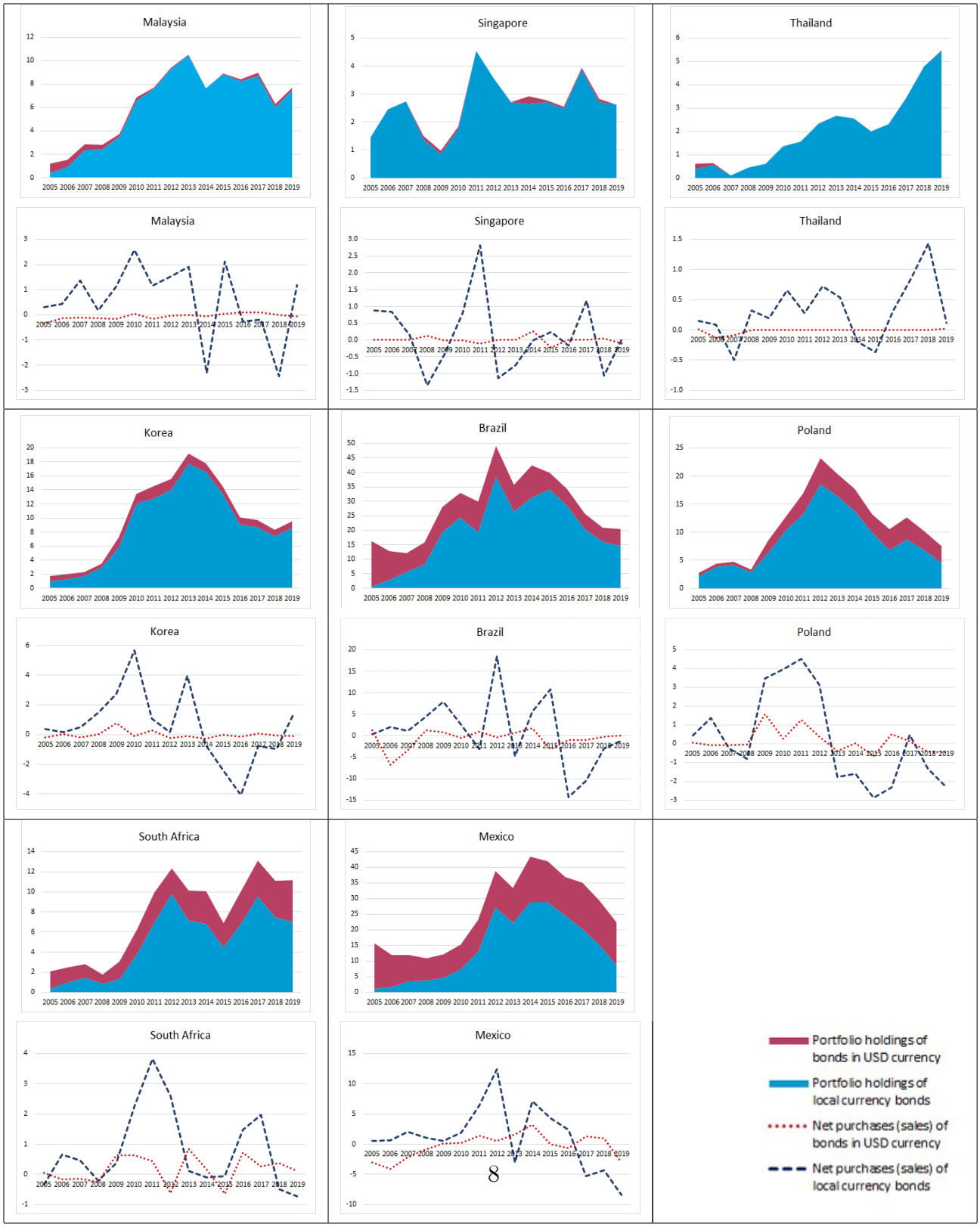

Figure 2: **High local currency holdings.** This figure shows a sample of countries where US investors mostly hold government bonds denominated in local currency. The areas capture the total value amount of holdings (USD billion). The dotted lines show net purchases (sales). Blue areas and lines indicate holdings and flows denominated in local currency. Red areas and lines indicate holdings and flows in USD denominated currency.

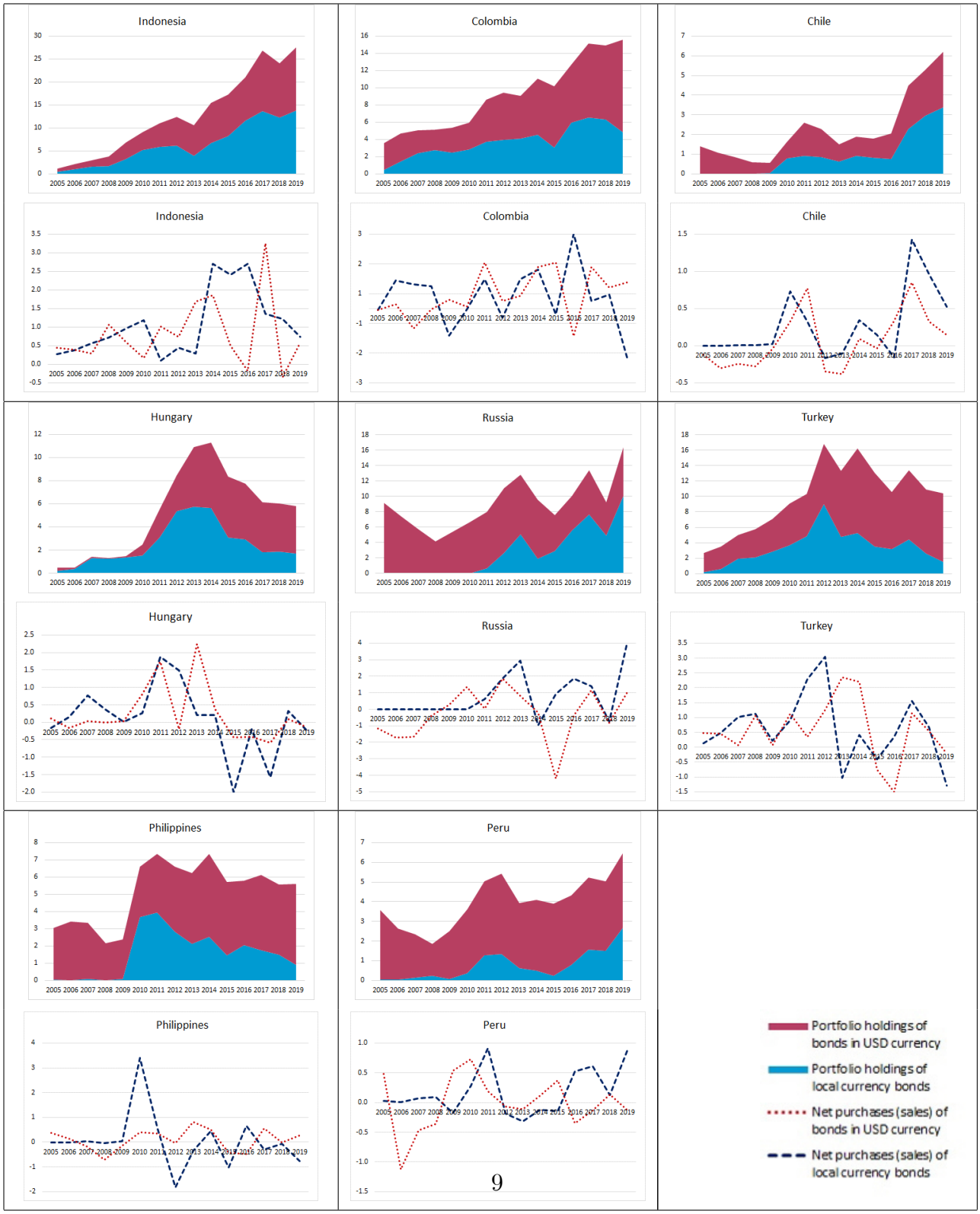

Figure 3: **Low local currency holdings.** This figure shows a sample of countries where US investors hold government bonds denominated in both USD and local currency. The areas capture the total value amount of holdings (USD billion). The dotted lines show net purchases (sales). Blue areas and lines indicate holdings and flows denominated in local currency. Red areas and lines indicate holdings and flows in USD denominated currency.

3 Investor type analysis

Our first main contribution is to examine the differences across seven investor sectors in their portfolio adjustment decisions. The seven sectors are: pension funds, insurance companies, depository institutions, non-financial investors, "other funds", "other financials" and mutual funds. 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 sectors, we know the year-end market value of government bond holdings of each issuer by currency of denomination since 2014, and thus we have snapshots of their year-end holdings of both local currency and US dollar bonds, by country. 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.

The top panel of Figure 4 shows the outstanding market value (in USD billion) of local currency government bonds by type of investor since 2004. Mutual funds stand out as the largest holder of these bonds, accounting for 60% of US resident holdings, averaged across years. The equivalent median figure is 64%. 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 (20%).

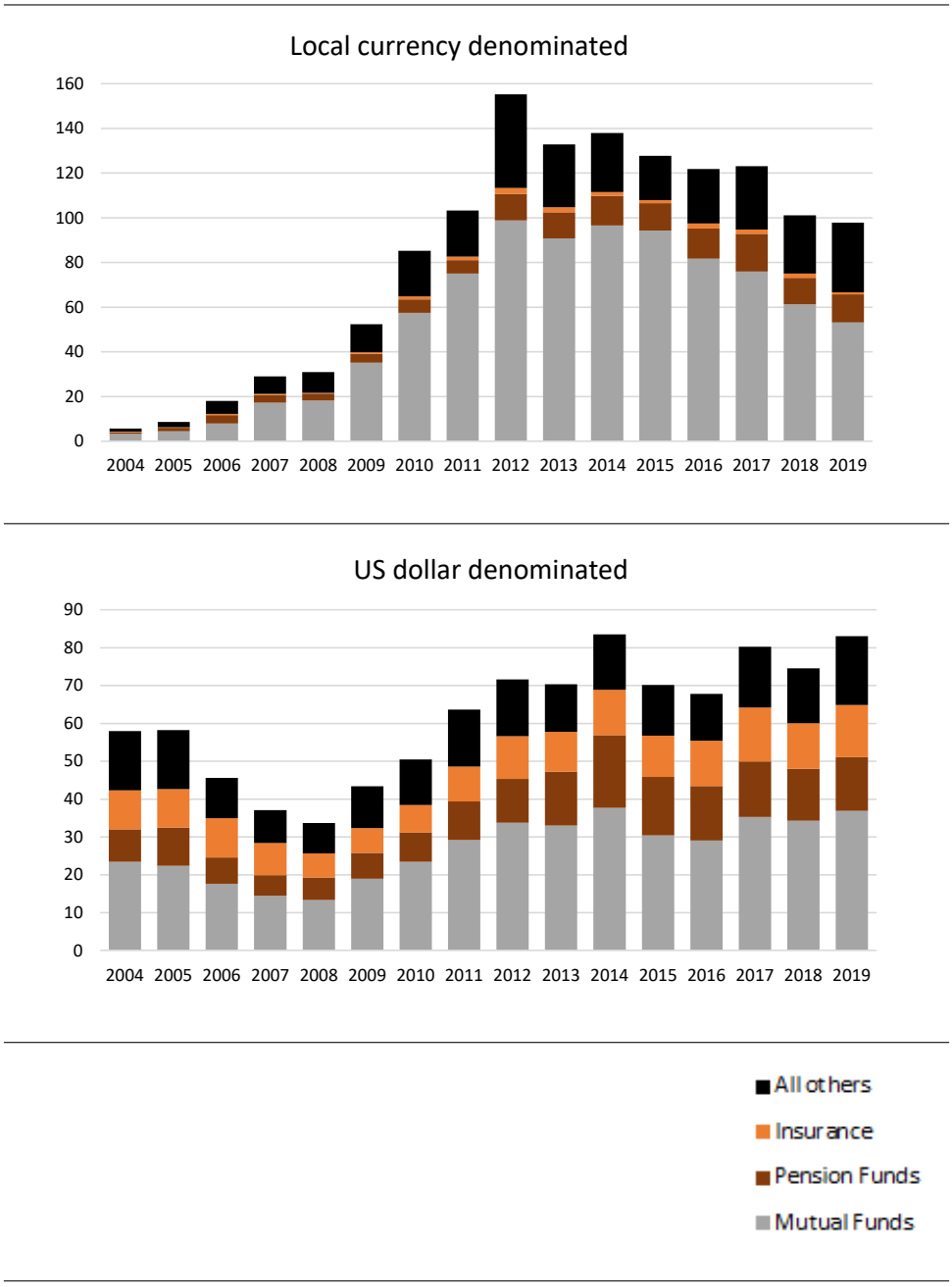

Figure 4: **Local currency and US dollar bond holdings by investor type.** This figure shows the holdings (USD billion) of government bonds that are denominated in local currency or US dollars for our sample of sixteen EMEs by type of investor: Mutual Funds, Pension Funds, Insurance, and All Others.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

Pension funds are the second largest sector in terms of market value of holdings, with an average (median) holding figure of 12% (10%), and a standard deviation that is half of that of mutual funds (11%). The insurance sector holds little EME local currency bonds, accounting for 2.6% 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 25% of US resident investors. Below, we investigate them separately, as disaggregated data became available only in 2014.

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. 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 2019.

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 40%. Also notable is how their holdings rise and fall more moderately over the sample.

The insurance sector and pension funds sector figure prominently as holders of US dollar denominated bonds, with average shares of 22% 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.

Table 1 presents evidence from a panel regression analysis of the cross-section sensitivity of

Table 1: **Investor Type Analysis** This table shows panel regressions where the dependent variable is the annual percentage change in notional holdings of emerging market government bond flows denominated in local currency (columns 1 to 5) or US currency (column 7), or 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: 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 US broad dollar index. Country and investor type fixed effects are included, except in column 1 (country only) and column 5 (country-investor type). Standard errors are corrected by clustering at the year level. ***, **, 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	USD
Sector	All	Mutual	Non-Mutual	All	All	All	All
ΔUSD Broad	-2.0163**	-2.9046**	-1.7179	-2.8567**	-2.9046**	-2.8442*	-1.8517*
	[0.9109]	[1.2386]	[1.1799]	[1.1999]	[1.2412]	[1.3964]	[0.9439]
Insur*ΔUSD Broad				0.8415	0.9258	0.0933	1.0870*
				[1.5645]	[1.6195]	[1.7860]	[0.5616]
Pension*ΔUSD Broad				1.4579	1.5036	1.0904	2.0693***
				[2.5982]	[2.6862]	[1.4090]	[0.5025]
All Others*ΔUSD Broad				1.0678	1.1439	0.7722	0.3421
				[1.5906]	[1.6417]	[1.0882]	[0.3986]
Constant	0.2140***	0.2729***	0.1941**	0.2140***	0.2139***	0.1661	0.0461
	[0.0700]	[0.0886]	[0.0807]	[0.0701]	[0.0719]	[0.0984]	[0.0496]
Observations	895	226	669	895	895	843	839
R-squared	0.033	0.047	0.034	0.034	0.048	0.041	0.082

holdings of the investor types: mutual funds, pension funds, insurance, and all others. The focus is on the determinants of the holdings and how they fluctuate with shifts in the dollar exchange rate.

The dependent variable in our analysis is the change in notional holdings of emerging market government bond flows denominated in local currency, by investor type. Notional holdings are a better reflection of the underlying portfolio adjustment decisions, as they control for valuation effects due to changes in yields and exchange rates. We construct these measures of notional holdings 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.

For columns 1 to 5, our dependent variable is the percentage change in the notional holdings of local currency-denominated emerging market government bond flows, by investor type. The changes in the holdings are regressed on the percentage change in the exchange rate. The exchange rate used is the Federal Reserve's broad dollar index. Depending on the sample used, we control for country fixed effects, country and investor type or country-investor type fixed effects. We exclude five observations as outliers, but results are robust to including them.

Column 1 reports the pooled results for all US investors. We note that the coefficient of $\Delta\, USD\ Broad$ is negative and statistically significant, indicating that notional holdings respond to shifts in the broad dollar index at the annual frequency.

However, the mutual fund sector shows a particularly strong relationship between a stronger dollar and a contraction in notional portfolio holdings. 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. When we limit the sample to mutual funds and include country fixed effects, the coefficient estimate of $\Delta\, USD\ Broad$ is negative and statistically significant (column 2). A one percent appreciation in the broad dollar index is associated

with a 2.9% decrease in the notional holdings.

In column 3 we exclude mutual funds from the sample and add investor type fixed effects. We see that the coefficient for $\Delta USD\ Broad$ is no longer statistically significant, suggesting that sectors other than mutual funds do not display the same sensitivity with respect to the dollar displayed by mutual funds.

We delve deeper by examining each US investor type by interacting the US broad dollar index in sequence with a number of dummy variables (one for each investor type). The dummy variables 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 coefficients reflect 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. Column 5 includes country-investor type fixed effects with unchanged results.

Column 6 confirms that our evidence is robust to constructing the local currency holdings variable differently. Here, the size of the local investment flows is captured by the total amount of investment 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 coefficient for $\Delta USD\ Broad$ are very similar to the estimations in columns 4 and 5.

In column 7 we consider notional value of investments in USD denominated bonds by type of investor as our dependent variable, and we run a similar analysis as in column 5. As was the case of local currency bonds, we find that when the dollar appreciates, mutual funds again reduce their investments in local currency bonds. However, in contrast to the case of local currency bonds, pension funds and insurance *increase* their investments following dollar appreciation. Specifically, the absolute value of the coefficient related to the pension funds sector (+2) is almost identical to the coefficient related to mutual funds (-1.8).

These findings suggest that for the dollar-denominated bonds, pension funds and insurance companies play a buffering role when mutual funds sell. Given the stickier nature of insurance and 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), but we leave investigation of these features for a future follow-up.

Overall, the message is that the notional holdings 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). In the case of USD-denominated bonds, pension funds and insurance companies appear to play a buffering role that counterbalances the portfolio shifts by mutual funds (both in terms of magnitude and direction of the flows). In any case, both for local currency bonds and dollar-denominated bonds, the fluctuations in the broad dollar index is an important determinant of adjustments in emerging market government bond holdings. Taken together, our findings are suggestive of a global portfolio adjustment effect by US mutual funds that goes beyond the individual country exchange rate effect. 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 Exchange rates and other investor types

Our main analysis has the broad US dollar index as the global factor capturing the investment portfolio allocations of global investors. Columns 1 and 2 of Table 2 replicate the analysis in Table 1, columns 5 and 7, respectively, by using the bilateral exchange rate in lieu of the US broad 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 1, the coefficient estimate of $\Delta Bilateral$ is negative and statistically significant, thus confirming that mutual funds have a procyclical behavior to exchange rate changes. However, the estimated coefficient of $\Delta Bilateral$ is -1.27, which is about half of the estimated coefficient of $\Delta USD\ Broad$ (-2.9). The two coefficients are

also statistically different. This evidence suggests that a global factor is at play, namely global investors responding to risk-off and risk-on periods, and it does have a greater impact that the individual country exchange rate dynamics.

For the case of US currency bonds in column 2, only the coefficient of $\Delta Bilateral$ related to the incremental effect of pension funds is statistically significant. This is different from the results in column 7 of Table 2 where the coefficients of mutual funds and insurance were statistically significant. However, also in this case, the coefficient of $\Delta Bilateral$ is significantly smaller than the $\Delta USD\ Broad$ one (0.47 vs 2), confirming the importance of the global investors channel.

The preceding analysis 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 5 shows the outstanding market value (in USD billion) of government bonds denominated in local currency by each type of US investor for the period 2014-2019. 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 1.9% and a median of 0.4% with respect to all the US investors.

The sector "Other financials", comprising of entities like broker dealers, account on average for 7% 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 8% 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 8% of the total US investments, and they have their largest presence in countries like Chile, Peru, Hungary and Indonesia.

Table 2: **Investor Type Analysis** This table shows panel regressions where the dependent variable is the annual percentage change in notional holdings of emerging market government bond flows denominated in local currency (columns 1 and 3) or US currency (columns 2 and 4). Columns 1 and 2 refer to the period 2004-2109 and for the following investor types are: pension funds (Pension), insurance companies (Insur), mutual funds, and All others (depository institutions, non-financial investors, other funds, other financials). Columns 3 and 4 refer to the period 2004-2019 and for the following investor types: depository institutions (DepInst), non-financial investors (Nonfin), other funds (OthFunds), and other financials. USD Broad is the annual percentage change in the US broad dollar index. Country-investor type fixed effects are included. Standard errors are corrected by clustering at the year level. ***, **, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

	(1)	(2)	(3)	(4)
Dependent variable	Local	USD	Local	USD
Sector	All	All	Others	Others
Period	2004-2019	2004-2019	2014-2019	2014-2019
ΔBilateral	-1.2787**	-0.4955		
	[0.4712]	[0.3213]		
Insur*ΔBilateral	-0.3885	-0.0769		
	[0.6317]	[0.2638]		
Pension*ΔBilateral	0.5720	0.4761**		
	[0.7359]	[0.2198]		
All Others*ΔBilateral	0.6727	-0.1598		
	[0.6776]	[0.2099]		
ΔUSD Broad			-5.3780**	-1.9094*
			[1.6981]	[0.8101]
DepInst*ΔUSD Broad			1.9404	0.0423
			[2.8297]	[1.2699]
Nonfin*ΔUSD Broad			6.0940**	0.3963
			[1.6972]	[1.8063]
OthFunds*ΔUSD Broad			6.4534	-2.5107*
			[5.3129]	[1.0481]
Constant	0.2145***	0.0768	0.0742	0.0892*
	[0.0680]	[0.0441]	[0.0735]	[0.0398]
Observations	895	839	318	292
R-squared	0.053	0.106	0.122	0.147

Figure 5 (lower panel) shows the analogous information, but for dollar-denominated bonds. Among the “All others" category, the "Other financials" have on average the largest share of US investors across countries and years.

In Table 2 we replicate the analysis of Table 1 for this subset of investor types and the shorter time series for which they are available (2014-2019). We interact the US broad dollar index in sequence with a number of dummy variables (one for each investor type) that takes the value 1 in the case of that specific investor type, and 0 otherwise. The default sector is the "other financial institutions", so that the size of the coefficients reflect the difference of each sector in relation to the other financial institutions sector.

Column 3 shows results when the dependent variable is the percentage change in the notional holdings of local currency-denominated bond flows, by investor type. The coefficient of Δ*USD Broad* is negative and statistically significant, meaning that the other financial institutions are procyclical, similarly to the mutual funds. In contrast, the coefficient of Δ*USD Broad* interacted with the category dummy of "Non financials" is positive and significant, highlighting some absorbing role by such investors when mutual funds and other financial institutions sell following dollar appreciation.

Finally, column 4 shows results when the dependent variable is the percentage change in the notional holdings of USD currency-denominated bond flows, by investor type. Here we see that, in addition to the "Other Financial institutions", also the "Other Funds" manifest their procyclical behavior to dollar fluctuations.

Taken together, these results suggest that other financial institutions like broker-dealers tend to have a procyclical behavior similar to the mutual funds and for any currency denomination of the bonds. Other funds like hedge funds tend also to be procyclical, but only with respect to dollar denominated bonds.

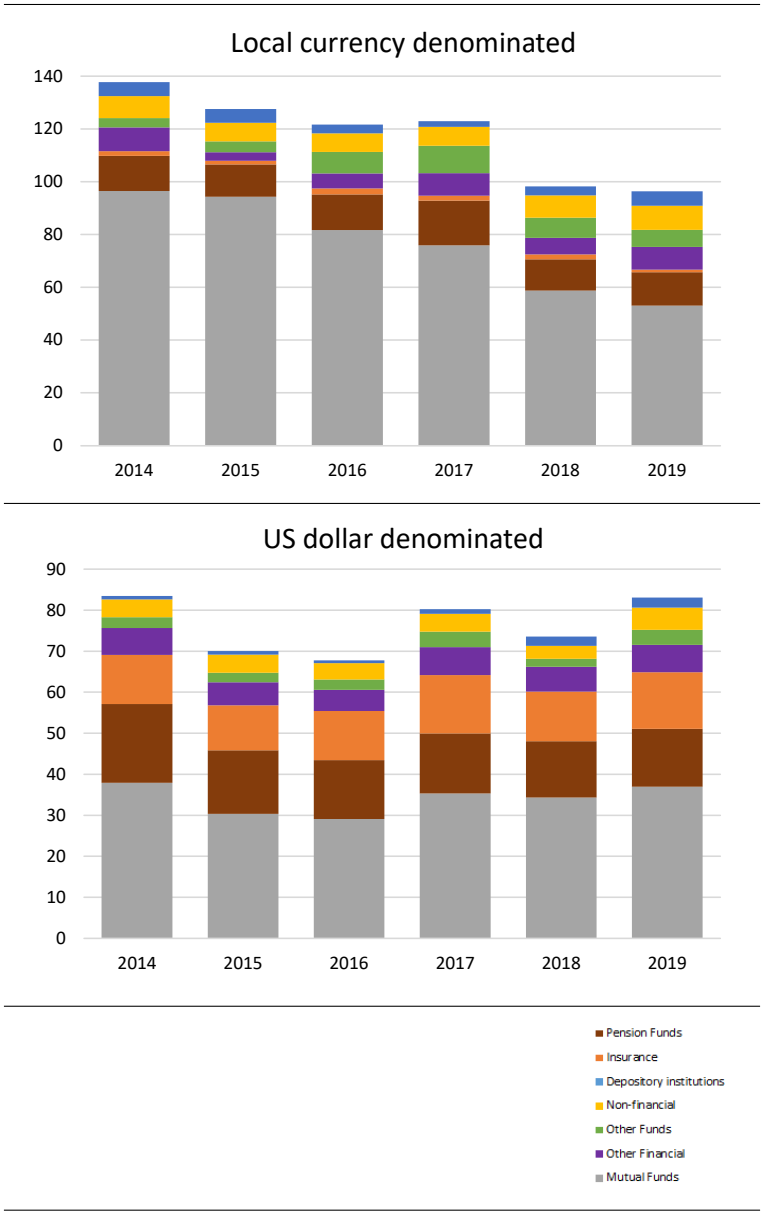

Figure 5: **Local currency and US dollar-denominated holdings by investor type.** This figure shows the holdings (USD billion) of government bonds that are denominated in local currency or US dollars for our sample of sixteen EMEs by type of investor over the period 2014-2019: Mutual Funds, Pension Funds, Other Funds, Depository Institutions, Other Financial Institutions, Non-financial institutions, and Insurance.

4 Dynamics of portfolio flows

We now turn to the second main contribution of our paper, which uses monthly data to examine the time series properties of portfolio shifts.

We utilize the monthly TIC portfolio data discussed in Bertaut and Judson (2014; 2015) and examine the time series properties of portfolio holdings, especially the triangular relationship between portfolio holdings, exchange rates, and financial conditions. Figure 5 shows the monthly fluctuations (in blue) of the net purchases (sales) of government bonds (USD million) together with the bilateral exchange rate vis-à-vis the US dollar (in green) for Thailand and Malaysia. An increase in the bilateral exchange rate indicates a depreciation of the local currency. From the annual TIC survey data, we know that US investment flows into Thai government bonds are exclusively into local currency-denominated bonds over the period 2012-2019, and flows into Malaysian government bonds are between 97% and 100% local currency-denominated.

Figure 6 shows a negative correlation between US investment flows and the dollar bilateral exchange rate. For Thailand (Malaysia), the contemporaneous correlation between US flows and the dollar exchange rate is -0.17 (-0.13), while the correlation between the dollar exchange rate and one-month ahead US flows is -0.26 (-0.17), meaning that US investment outflows from local government bonds are associated with local currency depreciation, which appears to have a negative feedback effect on the next month US flows that amplifies investment outflows.

More formally, we estimate a structural panel VAR for a sample of bonds of the 16 EMEs presented in Figures 2 and 3: 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 spreads. The data is at monthly frequency and span the period from January 2012 to December 2019.

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,

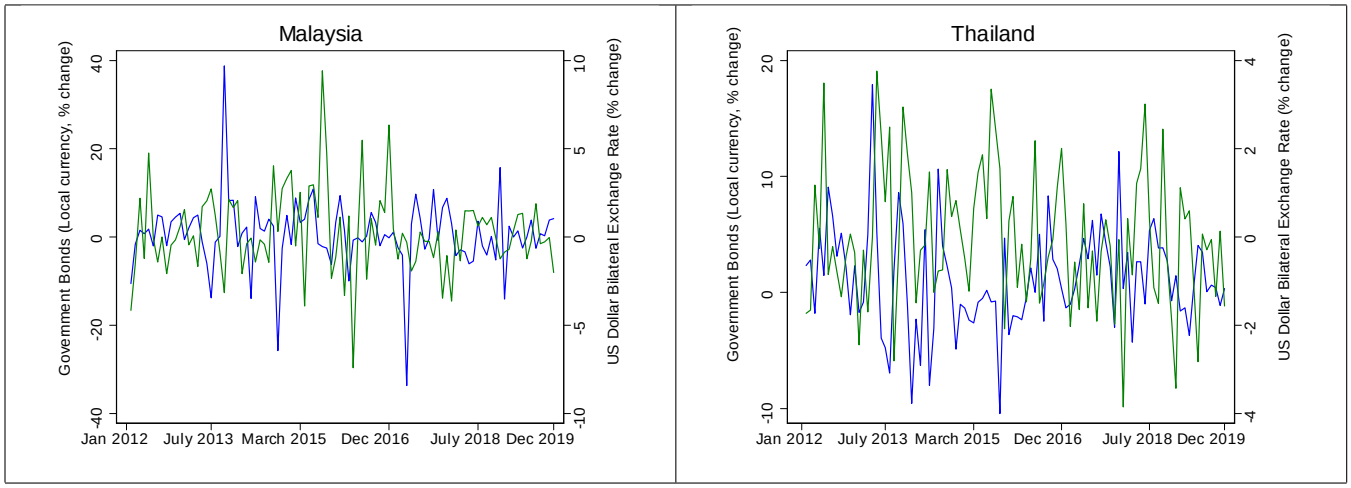

Figure 6: **Local currency bonds and the US dollar** This figure shows the monthly net purchases (sales) of government bonds (left vertical axis, blue line) and the monthly percentage change of the bilateral exchange rate vis-à-vis the US dollar (right vertical axis, green line) for Thailand (left panel) and Malaysia (right panel).

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 containing the following three variables of interest: investment flows of all US investors in the emerging market government bonds, exchange rate, and local currency spreads. We then augment the benchmark specification to account for global and local factors underlying the changes in investment flows and prices, including US monetary policy, volatility or GDP growth.

The recursive order of the benchmark specification is as follows: US investment flows in government bonds of each above-mentioned country, the bilateral US exchange rate, and country-specific local currency government bond spreads. This means that US investment flows to each country can have contemporaneous and lagged effects on exchange rates and local spreads; that exchange rates can have contemporaneous and lagged effects on local spreads, 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 notional monthly portfolio flows following the methodology described in Bertaut and Judson (2014; 2015). The monthly TIC SLT data are collected in aggregate at market value and in US dollars, 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 2012-2019.

Bilateral exchange rates are from Bloomberg and measure foreign currency per US dollar, so an increase indicates US dollar appreciation.

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 (2019). 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 3: **Summary Statistics.** This table shows summary statistics of our main variables of interest for the sample of sixteen EMEs. Portfolio flows is the notional monthly portfolio flows of US investors in EMEs government bonds (in percentages). Bilateral exchange rate measures foreign currency per US dollar (in percentages). US Broad dollar index is the percentage change in the Federal Reserve US Broad 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
Portfolio Flows %	1,536	0.227	5.504	-0.053	-2.089	2.284
Bilateral Exchange rate %	1,536	0.366	3.169	0.152	-1.284	1.840
US Broad dollar index %	1,536	0.225	1.502	-0.042	-0.816	1.338
Local Spreads	1,489	3.801	3.208	3.463	1.364	5.650

5 Results

5.1 Baseline specification

Figure 7 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 three countries where US investments in government bonds are denominated almost entirely in local currency over the period 2012-2019: Thailand, Malaysia, and Singapore. For this sample of countries, the variation in the monthly investment flows is entirely 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 bilateral exchange rate and shows the core result of our analysis. A one percent appreciation of the dollar in terms of the bilateral exchange rate leads to a drop in local currency investment flows by 0.44% after one month (left chart), suggesting that local currency denominated bonds do not seem to be insulated by exchange rate fluctuations. As dollar appreciation is also associated with a simultaneous increase in local spreads by 0.02 (right chart), dollar-based investors "suffer 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.

Taken together, the evidence from the middle panel of Figure 7 highlights the "wind-chill" effect whereby investors who evaluate returns in dollar terms are affected both by the valuation effect due to dollar appreciation, as well as the impact on local currency yield spreads. US

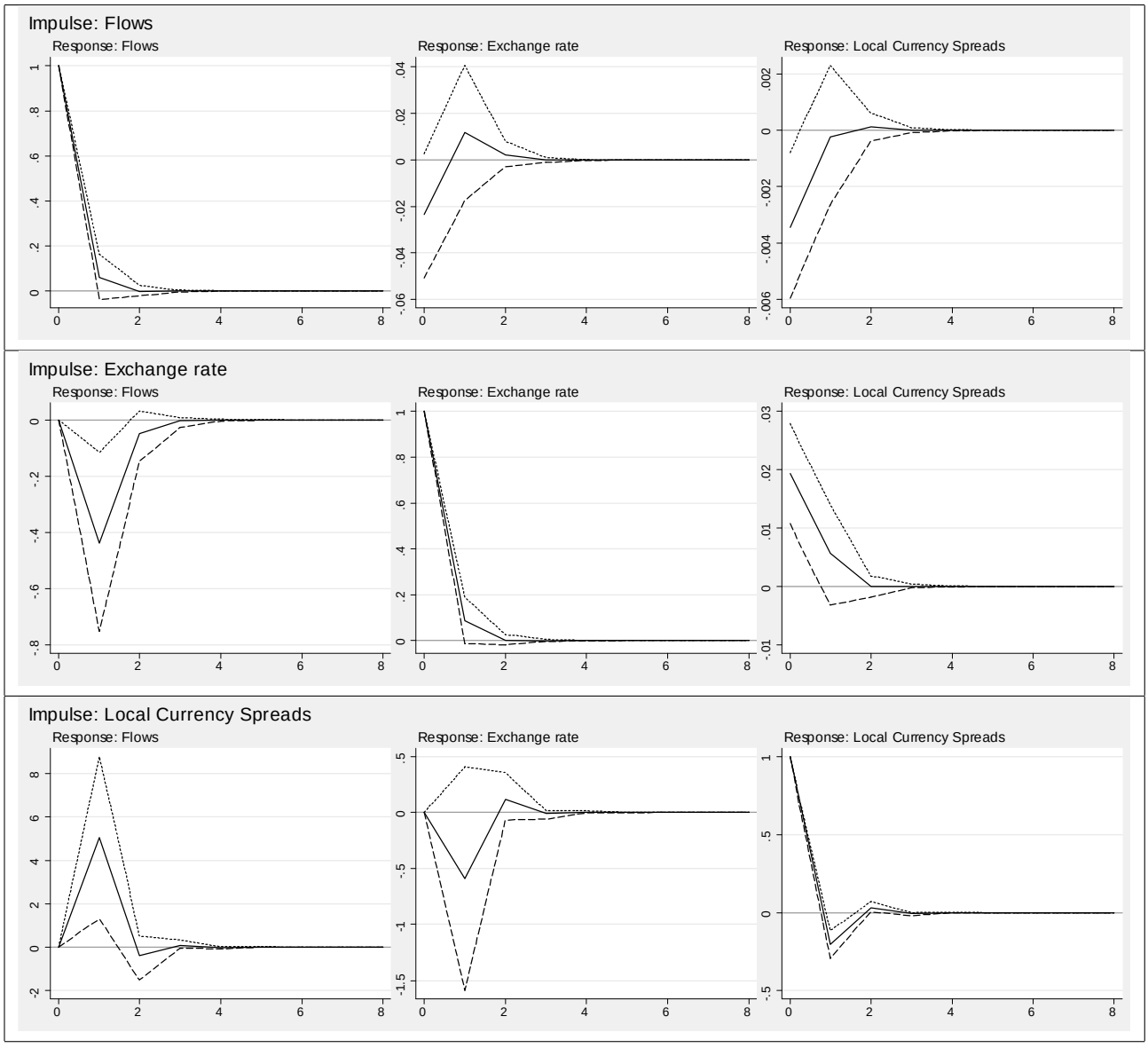

Figure 7: **Impulse response functions in recursive VAR - Sample of three countries.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, bilateral exchange rate vis-à-vis the US dollar, and local currency spreads) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Thailand, Malaysia, and Singapore.

investors have to deal with the effect of currency movements (the wind chill) on top of the underlying local currency returns (the temperature). For this reason, local currency bonds in EMEs tend to 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 (Carstens and Shin, 2019).

Furthermore, we can circle back to the panel analysis in Section 3. Our analysis using the monthly TIC data allow us to analyze the relationship between portfolio flows and exchange rates in a way that we cannot see at annual frequency. Given that US mutual funds are the largest holders of EME local currency bonds, we can also infer that they are the main drivers of the association between exchange rates and portfolio flows.

The upper panel of Figure 7 reports IRFs to a one percent shock of the US investment flows into a country's government bonds. A one percent increase in US bond holdings leads to a contemporaneous 0.023% depreciation of the US dollar (albeit marginally insignificant) and to a contemporaneous decrease in local currency spreads by 0.035.

The limited impact on the exchange rate may be due to the differential reactions of investors - for instance, between foreign and domestic investors, as well as different groups of foreign investors (Ng, Shim and Vidal Pastor, 2019). Yet, in perspective, the economic magnitude is economically significant. Over the considered sample period and for the sample of the three countries, the US dollar bilateral exchange rates appreciate on average by 0.08%, while the average change in local spreads is -0.013.

The bottom panel of Figure 7 reports IRFs to a one unit shock in the local government bonds spread. A one basis point increase in local spreads leads to an increase in investment flows by 0.05% after one period. We interpret this result as evidence suggesting a "search for the yield" behavior by investors in the month following the increase in local spreads and dollar appreciation.

Figure 8 replicates the empirical exercise shown in Figure 7 for a larger sample of countries, i.e., the eight countries with the highest US investors' holdings of local currency bonds (as listed in Figure 2). Qualitatively, the results are the same. In the middle panel, however, we

see that a one percent appreciation of the dollar in bilateral exchange rate terms leads to a drop in local currency holdings by 0.22% after one month, which is about half of the decline in investment flows we saw in Figure 7. These findings of attenuated effects are perhaps not surprising given that monthly investment flows also include US dollar denominated bonds for some of the countries in the sample.

The Appendix shows IRFs of the 3-variable benchmark specification for the sample of all sixteen countries and for the subsample of countries with low US investments in local currency bonds. Figure 12 shows qualitatively similar results for the entire sample of countries. However, the effect of an exchange rate shock on investment flows becomes statistically insignificant for the subsample of countries with large investments in US dollar denominated bonds (Figure 13). This is consistent with the evidence in Table 1 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.

5.2 Additional factors

We turn now to some additional factors that may be associated or directly cause fluctuations in investment flows and exchange rates. Bruno and Shin (2015b) find that a contractional shock to US monetary policy leads to a decrease in cross-border banking capital flows. 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 et al. (2013) show that a cut in the Fed Funds rate is followed by a dampening of the VIX index. We therefore augment our benchmark three-variable VAR by considering the US monetary policy as a global factor that affects US investors' decisions also outside the United States.

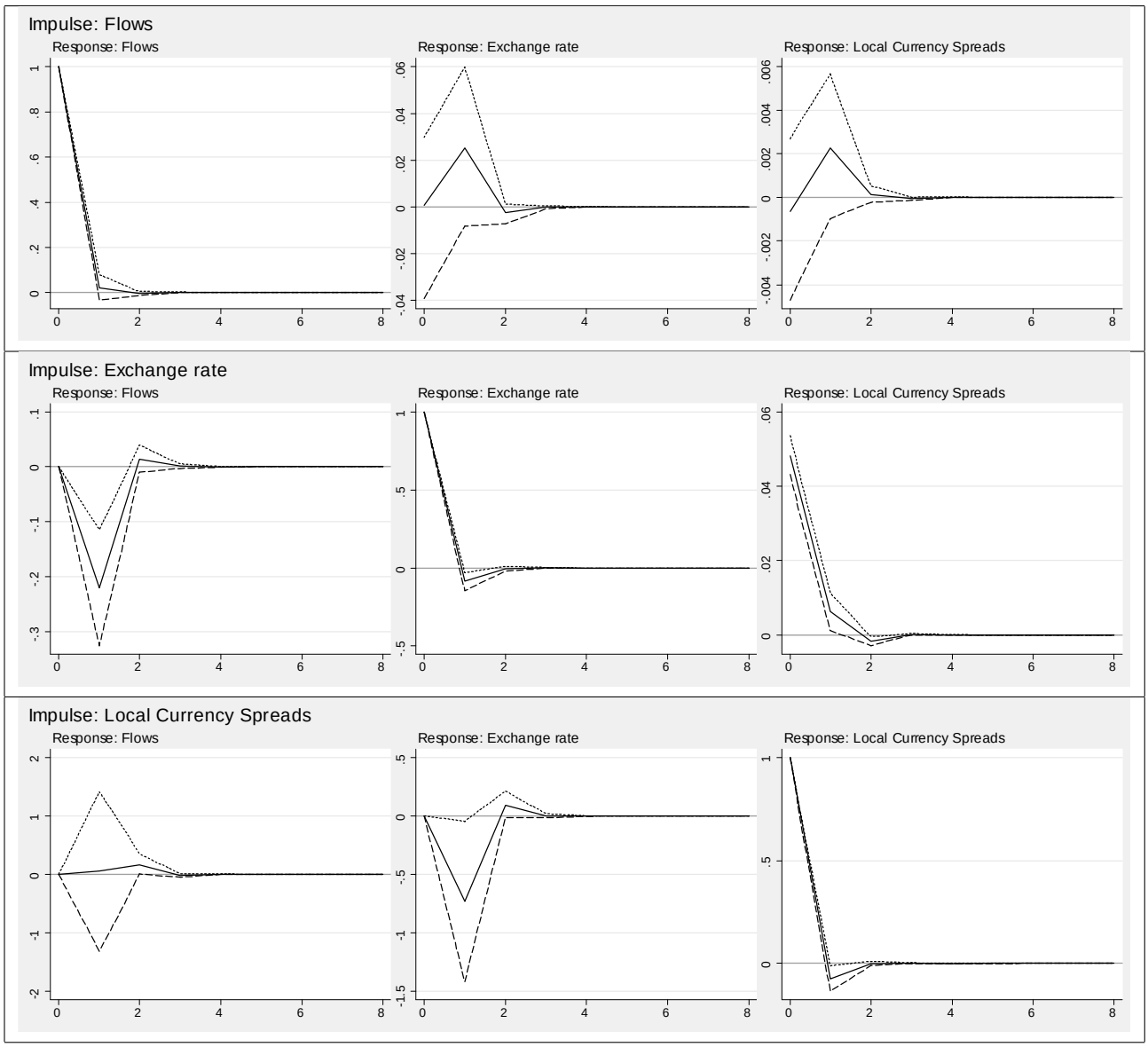

Figure 8: **Impulse response functions in recursive VAR - Sample of countries with US investments mostly in local currency bonds.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, bilateral exchange rate vis-à-vis 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.

5.2.1 US Monetary Policy

Figure 9 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, exchange rate, and local currency spreads. US monetary policy is measured as the change in the Wu-Xia (2016) shadow rate.[2] The sample is restricted to eight countries with high US investment holdings in local currency government bonds (Figure 2).

The top panel of Figure 9 reports IRFs to one percent shock in US monetary policy. A one percent increase in the US interest rate leads to a statistically significant drop in local currency investment flows in the next eight months: -2.6% after one month, -1% after two months, -0.44% after three months, -0.2% after four months, -0.08% after five months, -0.04% after six months, -0.02% after seven months, and -0.007% after eight months. This suggests that US monetary policy significantly affects US investments decision in non-US local currency denominated bonds with a prolonged effect over time.

The third chart of the top panel of Figure 8 shows an immediate reaction in the bilateral exchange rate following a US monetary policy shock. A one percent increase in the US interest rate leads to a statistically significant and immediate appreciation of the US dollar by 3.6%. The third panel, second chart from the left, of Figure 9, reveals related aspects of the mechanism at play. A one percent appreciation of the US dollar leads to a 0.2% drop in the investment flows one month later.

Thus, the conjunction of the second and third chart in the top panel and of the second chart in the third panel of Figure 9 tells us the following narrative. Consider first the impact of a shock to the Fed Fund rate. An increase in the rate leads to a drop in investment flows after one month and to an immediate appreciation of the US dollar exchange rate, which in turn leads to a drop in investment flows after one month, thus amplifying the government bonds sell-off. Taken together, this result confirms the impact of exchange rates on investments decisions even after controlling for monetary policy shocks.

[2] https://www.frbatlanta.org/cqer/research/wu-xia-shadow-federal-funds-rate

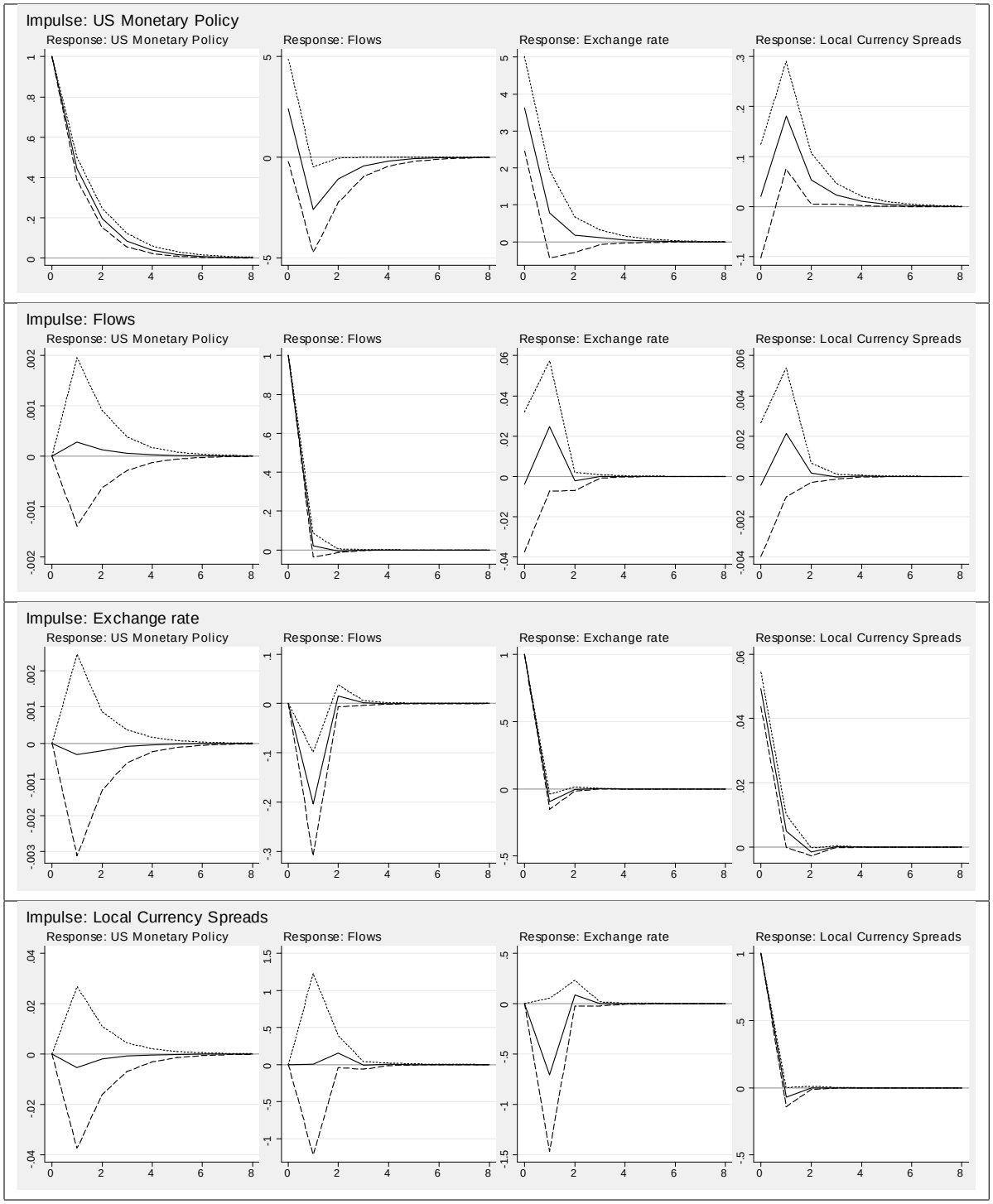

Figure 9: **Impulse response functions in recursive VAR - US Monetary policy.** This figure presents estimated impulse-response function for the four variable recursive VAR (US monetary policy, US investment flows in government bonds, bilateral exchange rate vis-à-vis the US dollar, and local currency 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.

5.2.2 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 10 reports IRFs to one point increase in the VIX. We see that US flows decrease by 0.12% after one month, the bilateral exchange rate appreciates at t=0 by 0.23%, and local currency spreads increase at t=0 by 0.014. Importantly, in the third panel of Figure 10 we see that a one percent appreciation in the bilateral exchange rate has a further negative effect on US flows at t=1 by 0.2%, thus amplifying the negative effect deriving from a shock on the VIX, and confirming the importance of the exchange rate channel for US investors of local currency bonds.

5.2.3 Broad Dollar Index

The preceding analysis uses the bilateral exchange rate as the reference exchange rate. We replicate the benchmark specification by using the broad dollar index in lieu of the bilateral 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, the risk-taking channel of exchange rates due to Bruno and Shin (2015a, 2015b) whereby a stronger dollar is associated with tighter credit conditions, operates more strongly through a broad dollar index rather than bilateral exchange rates (Avdjiev et al. (2019)).

Figure 11 shows the IRFs to a one percent appreciation of the broad US dollar index as measured by the FED FRED and for the sample of countries listed in Figure 2. The left chart shows that US investment flows decline by 0.32% after one month, consistently with the evidence on the bilateral exchange rate. Taken together, these results show that the US investors decisions are not only dictated by fluctuations in the bilateral exchange rates vis-a-vis the invested country currency, but also by broader portfolio reallocations in local currency bonds.

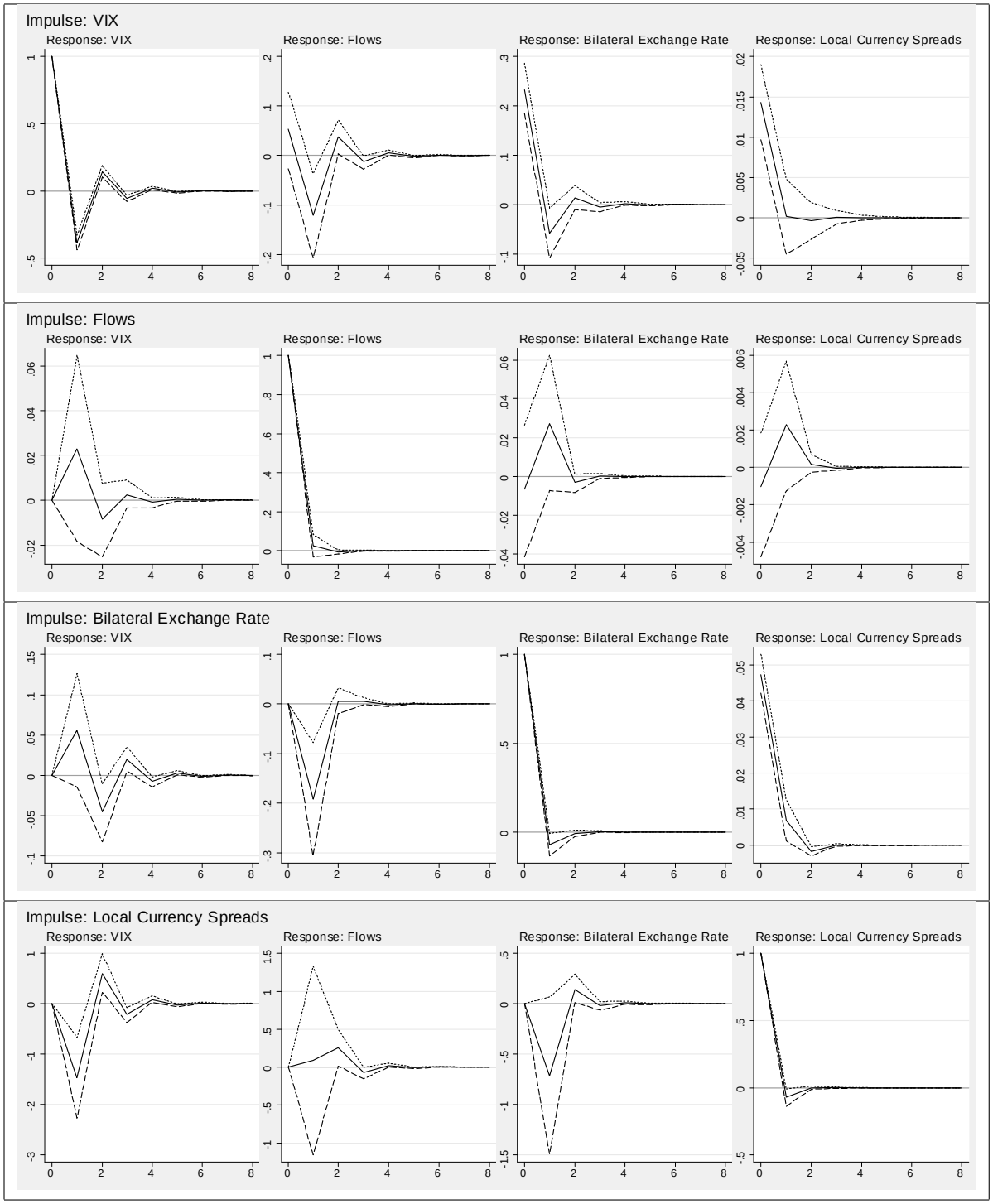

Figure 10: **Impulse response functions in recursive VAR - The VIX Index.** This figure presents estimated impulse-response function for the four variable recursive VAR (VIX, US investment flows in government bonds, bilateral exchange rate vis-à-vis the US dollar, and local currency spreads) and 90 percent 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.

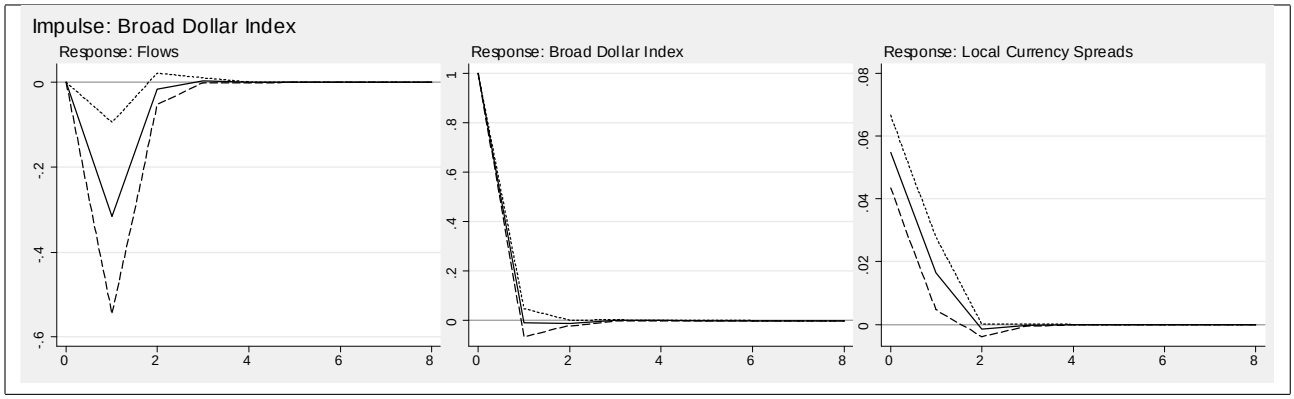

Figure 11: **Impulse response functions in recursive VAR - Broad US dollar index.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, broad US dollar index, and local currency spreads) and 90 percent confidence intervals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

6 Conclusions

Emerging market governments have largely overcome the "Original Sin" by issuing debt in local currency. However, the currency risk has migrated from the borrower to the investor. During periods of financial stress, portfolio outflows go hand-in-hand with rising yields and a depreciating currency.

Our paper has examined the triangular relationship between portfolio flows, exchange rates and financial conditions by utilizing a dataset that is well-suited to examining the broader macro themes associated with "Original Sin Redux". The comprehensive coverage of our dataset across all investor types allows us to study the comparative portfolio choice across seven investor types. We have found that the mutual fund sector displays a heightened sensitivity of portfolio flows to exchange rate changes and shifts in financial conditions. In addition, our dataset allows measurement of the portfolio holdings of the respective investor sectors that "sees through" the liquidity management operations of mutual funds, thereby facilitating a broader macro assessment.

In terms of the dynamics, our panel VAR exercise for a sample of 16 emerging market

economies reveals the channels of transmission more clearly. In countries where US investor portfolios are almost exclusively denominated in the local currency of the borrower, a one percent appreciation of the dollar bilateral exchange rate leads to a drop in local currency holdings of 0.44% after one month. In contrast, when US investor holdings are mostly dollar-denominated, fluctuations in the bilateral exchange rate do not statistically impact their flows. Results are robust to a battery of tests and factors that may be associated or directly cause fluctuations in investment flows and exchange rates.

Our results run counter to the conventional wisdom that emerging market woes are mostly attributable to currency mismatch on the borrower's balance sheet. If anything, the local currency-denominated bonds of emerging markets appear to display greater sensitivity of flows in reaction to shifting financial conditions. While the bilateral exchange rate comes through as a risk factor, the greater impact is displayed through fluctuations in the broad dollar exchange rate, suggesting that the risk-taking channel of exchange rates is an important determinant of financing conditions faced by emerging market governments.

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A Appendix

Figure 12 shows the impulse response functions (IRFs) of the 3-variables panel benchmark VAR model (US investment flows in government bonds, bilateral exchange rate vis-a-vis the US dollar, 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, Thailand, and Turkey).

Figure 13 shows the impulse response functions (IRFs) of the 3-variables panel benchmark VAR model (US investment flows in government bonds, bilateral exchange rate vis-a-vis the US dollar, 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 US investments in local currency bonds (Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia, and Turkey).

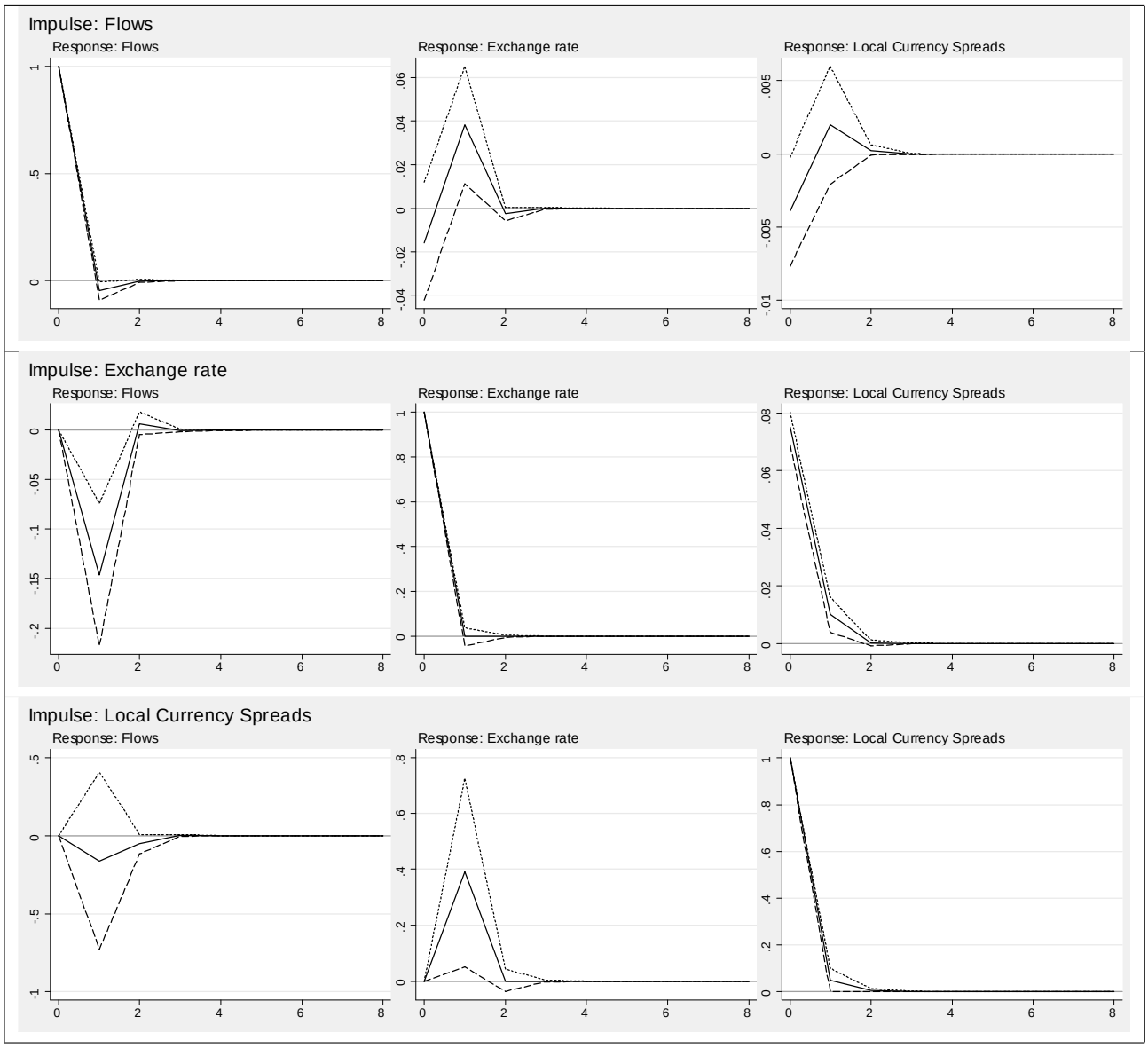

Figure 12: **Impulse response functions in recursive VAR - Sample of all 16 countries.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, bilateral exchange rate vis-à-vis the US dollar, and local currency spreads) and 90 percent confidence intervals estimated using Monte-Carlo algorithm with 500 replications. The sample consists of the following countries: Brazil, Chile, Colombia, Hungary, Korea, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Singapore, South Africa, Thailand, and Turkey.

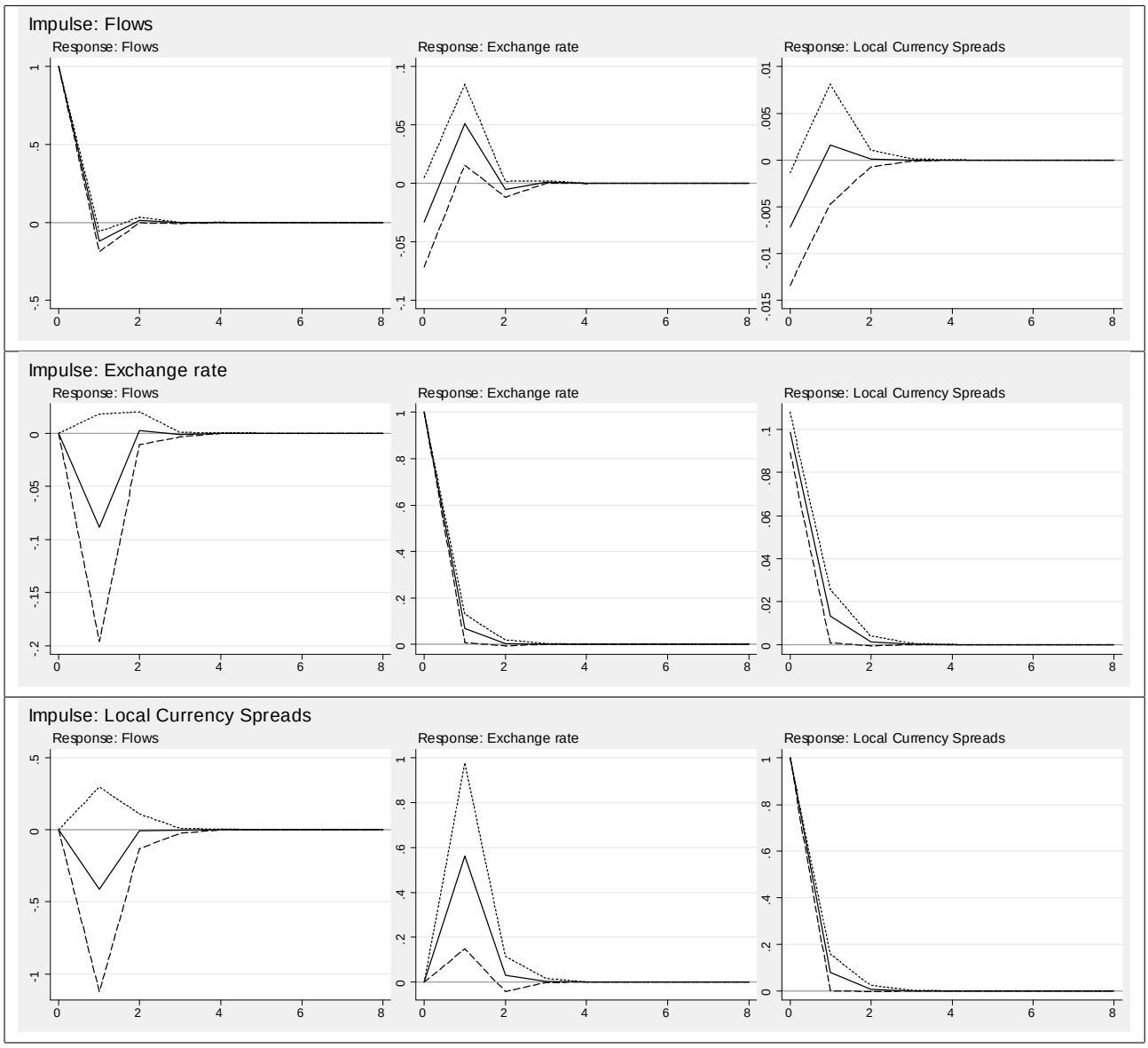

Figure 13: **Impulse response functions in recursive VAR - Sample of countries with US investments in both local and USD currency bonds.** This figure presents estimated impulse-response function for the three variable recursive VAR (US investment flows in government bonds, bilateral exchange rate vis-à-vis 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: Chile, Colombia, Hungary, Indonesia, Peru, Philippines, Russia, and Turkey.