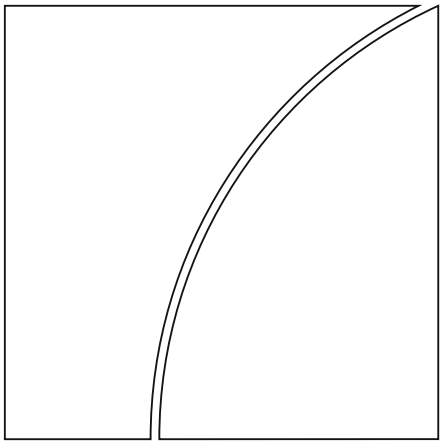

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by Jimmy Shek, Ilhyock Shim and Hyun Song Shin

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Investor redemptions and fund manager sales of emerging market bonds: how are they related?*

Jimmy Shek,† Ilhyock Shim‡ and Hyun Song Shin§

Abstract

Lending to emerging market economies (EMEs) through bond purchases has surged since 2009. What are the risks of a sudden stop? Bond mutual funds may curtail credit through two channels. The first is redemptions by ultimate investors. The second is additional discretionary sales by fund managers, over and above any sales implied by redemptions. In an empirical analysis of EME bond funds, we find that discretionary sales tend to reinforce the sales due to investor redemptions, and that 100 dollars' worth of bond sales due to investor redemptions is accompanied by roughly 10 dollars' worth of discretionary bond sales. We also find that 100 dollars' worth of EME international bond sales is associated with around 4 dollars' worth of valuation losses. Finally, a 1 percentage point increase in the yield of local currency bonds is associated with a 10% decline in the dollar value of bond holdings.

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† Senior Research Analyst, Bank for International Settlements, 78F, Two International Finance Centre, 8 Finance Street, Central, Hong Kong SAR, China.

‡ Principal Economist, Bank for International Settlements, 78F, Two International Finance Centre, 8 Finance Street, Central, Hong Kong SAR, China.

§ Economic Adviser and Head of Research, Bank for International Settlements, Centralbahnplatz 2, 4051 Basel, Switzerland.

1 Introduction

Our understanding of crisis propagation and the cross-border transmission of financial conditions has been heavily influenced by the events surrounding the 2008 crisis. Bank leverage and cross-border banking sector flows used to be at the heart of the narrative in the transmission of financial conditions.[1] Since then, the prolonged period of low global long-term interest rates has resulted in a shift in the pattern of financial intermediation as global banks have increasingly given way to long-term investors in the market for debt securities.[2] The transmission of financial conditions across borders has taken the form of "reaching for yield", declining risk premiums for debt securities and increased issuance of emerging market economy (EME) bonds that has ensued to satisfy the demand.

Evidence is also accumulating that monetary policy has been an important driver of the growth in dollar-denominated credit. McCauley, McGuire and Sushko (2015) estimate the outstanding amount of dollar-denominated credit to non-banks outside the United States at over $9 trillion, and find that the compression of the US Treasury term spread is an important driver of its growth. In a micro study of mutual fund flows, Kroencke, Schmeling and Schrimpf (2015) find that mutual fund flows obey a factor structure, with one of the factors capturing the stance of US monetary policy.

As the boom in EME bond issuance enters its mature stage, the focus has shifted to the consequences of a possible reversal of bond portfolio flows and the broader economic impact of a possible sudden stop.[3] Some re-orientation has been necessary in analytical frameworks to address the new economic mechanisms at play.

Long-term investors are often portrayed as a stabilising influence in financial markets, absorbing losses without insolvency and cushioning market shocks caused by leveraged players. However, recent episodes such as the "taper tantrum" of 2013 have shown that even long-term investors may have limited appetite for losses, and that they will join in a selling spree when one arrives.

Our paper is an attempt to address the empirical questions posed by possible market disruptions associated with fire sales of EME bonds. Bond sales may result either from the sales needed to meet investor redemptions or from discretionary sales beyond that implied by investor redemptions. How are the two elements

[1] The BIS report on global liquidity by the Committee on the Global Financial System (2011) provides an overview. See also Borio, McCauley and McGuire (2011), Avdjiev, McCauley and McGuire (2012), Bruno and Shin (2015a, 2015b) and Sobrun and Turner (2015).

[2] See Caruana (2013a, 2013b), Turner (2014) and Shin and Turner (2015). Shin (2013) has dubbed this period the "second phase of global liquidity", in which EME corporates have issued US dollar-denominated bonds, often in offshore financial centres (McCauley, Upper and Villar (2013)) and at longer terms, thereby exposing investors to greater duration risk (Gruić, Hattori and Shin (2014)).

[3] The title of a recent Bank of Mexico working paper captures the current sentiment. See M Ramos-Francia and S García-Verdú, "Is trouble brewing for EMEs?", *Bank of Mexico Working Paper*, no 2015-08. See also BIS (2015), the recent IMF Global Financial Stability Report (IMF (2015)), the earlier report of the US Treasury's Office of Financial Research on asset managers (OFR (2013)) and the speech by the SEC Chair, Mary Jo White, in December 2014 (White (2014)).

related? Specifically, we pose the following pair of questions in the context of mutual funds specialising in EME bonds.

- How much of the shifts in mutual funds' EME bond holdings are accounted for by redemptions on the part of ultimate investors? That is, are bond sales driven primarily by investor redemptions, or is there a significant role for discretionary bond sales?
- If discretionary sales take place, do they amplify sales driven by investor redemptions, or do asset managers cushion the investor-driven flows by "leaning against the wind" to buy beaten-down assets?

We find that discretionary bond sales are a significant part of total bond sales by EME bond mutual funds, and that discretionary sales by fund managers tend to reinforce the sales driven by redemptions by ultimate investors. The magnitudes are also found to be economically significant. One hundred dollars' worth of bond sales due to investor redemptions is accompanied by roughly 10 dollars' worth of discretionary bond sales. Thus, rather than cushioning the selling pressure on EME bonds during a redemption spree, there appears to be an additional significant impetus to the selling pressure due to fund managers' discretionary sales. An alternative perspective on discretionary sales is through the active cash management of the asset managers themselves. The co-movement of redemptions and discretionary sales reflects the hoarding of cash by fund managers in the face of greater anticipated redemptions amid unsettled market conditions.[4] The hoarding of cash might reflect efforts by the asset managers to maintain what they see as a prudent level of cash holdings in the face of market volatility and investor redemptions. However, what is prudent from the point of view of an individual asset manager may nevertheless give rise to concerted selling episodes that exacerbate one-sided markets and add to spillover effects on broader financial conditions.

The collective action problem associated with the hoarding of cash has a parallel in the systemic consequences of deleveraging by banks and other financial intermediaries. The leverage of banks and other financial intermediaries tends to be procyclical, rising during booms and falling in busts (Adrian and Shin (2010, 2014)). Cutting back leverage by curtailing lending may be prudent from the point of view of the lender, but to the borrower, it looks like a run. Procyclical leverage thereby has the potential to exacerbate systemic risk.[5] In the same vein, cash hoarding by asset managers may generate fire-sale externalities that exacerbate market liquidity conditions. This is so even if asset managers employ little leverage. The channel of spillovers is through shifts in the composition of assets, rather than deleveraging.

Our findings also raise deeper questions on the way that asset sales interact with the strategic incentives involved in investor redemptions. Although the net asset value of mutual funds adjusts to changes in underlying market values, redemptions by one group of investors may exert negative spillovers on remaining investors through the shifts in composition of remaining assets from liquid to illiquid ones, as well as the marked-to-market changes in the value of remaining assets. Goldstein, Jiang and Ng (2015) identify run-like incentives in corporate bond

[4] Active cash management is acknowledged by the asset management industry itself in their submissions to the official sector. See, for instance, PIMCO (2015, p 13) and Investment Company Institute (2015) who report that cash holdings of mutual funds rose from 6.3% to 11.9% during the global financial crisis, in spite of investor redemptions.

[5] See Morris and Shin (2008) for an analysis of systemic spillovers arising from deleveraging.

mutual funds created by the first-mover advantage and short-term liquidity concerns, and in turn draw parallels with the global game literature on bank runs. Indeed, the less liquid the underlying assets are, the greater are the spillover effects of investor redemptions to remaining investors, thereby exacerbating the selling pressures in a run-like episode (see Morris and Shin (2004, 2014) and Chen, Goldstein and Jiang (2010)). Raddatz and Schmukler (2012) also consider whether mutual fund investments into and out of countries are largely driven by investor flows that lead managers to liquidate positions across countries to maintain portfolio weights or by active changes in these country weights by fund managers. They show that neither fund managers nor investors are contrarian, especially during crises, and that their behaviour seems to amplify crises and transmit shocks. They also point out that, in the case of redeemable debt that affects bond mutual funds, short-term rollover decisions by investors are strategic complements and impinge on fund manager decisions.

A fund manager may anticipate further redemptions and try to secure enough cash to meet such redemptions. In turn, greater cash holdings will mitigate investors' incentive to run. Foreseeing these effects, greater discretionary sales by asset managers would then be a prudent response to anticipated redemptions. Nevertheless, the fund manager may face a delicate balancing act between selling too much into an illiquid market, thereby reducing net asset value, and securing enough cash to meet future redemption pressures and defusing the run-like incentives. Thus, in interpreting our results, we should be mindful of the joint determination of the investor redemptions and fund managers' discretionary sales. Whatever the underlying motivation and interactions, our finding that redemptions and discretionary sales are positively correlated provides a benchmark for future work.

In addition to addressing our main question, we provide evidence that a large share of EME bond funds have often experienced sizeable redemptions, especially during the period of EME bond market turbulence, and that EME bond funds faced more severe redemption shocks than AE bond funds. We also gauge the impact of bond yield changes on bond fund portfolio values. In particular, we calculate the sensitivity of returns to yield changes – the effective US dollar duration of EME bond funds. In dollar terms, we find a duration multiple of around 9 to 10 for global EME local currency bond funds, implying that a 1 percentage point increase in EME bond yields are associated with a 9−10% decline in the dollar value of the portfolio. These high numbers come from the exchange rate changes reinforcing the local currency price changes, when declines in local currency bond values coincide with the depreciation of the exchange rate against the dollar.

Our paper connects with a growing literature that examines the procyclical[6] investment behaviour of institutional investors (see, for instance, the study by the Procyclicality Working Group of the Bank of England (2014)). Investor flows into collective investment vehicles such as mutual funds, hedge funds and private equity funds also tend to be positively correlated with fund performance. As managers of these funds compete for flows, they tend to take more risk or use greater leverage to generate higher returns during good times. Axelson et al (2013) find that

[6] The Bank of England's Procyclicality Working Group (2014) defines procyclicality as investing in a way that exacerbates market movements and contributes to asset price volatility or investing in a way that exaggerates the peaks and troughs of asset price or economic cycles.

variation in economy-wide credit conditions is a key determinant of leverage in private equity-backed buyouts, generating procyclical leverage of target firms. Feroli et al (2014) show that, when mutual fund flows for certain fixed income securities are high, prices persistently rise, and that a feedback loop emerges; that is, high flows lead to rising prices, which attract more flows, which further raise prices. Burkart and Dasgupta (2015) provide a model in which competition for flow forces activist hedge funds to increase the leverage of target firms, making value enhancement procyclical.

The plan of the paper is as follows. Section 2 provides preliminary background to our empirical investigation, including a liquidity stress test across EME bond funds. Section 3 presents our main analysis of the co-movement and interaction of redemption-driven sales and discretionary sales. In Section 4, we calculate the sensitivity of US dollar returns of EME bond funds to changes in bond yields. Section 5 concludes.

2 Background

As a prelude to our main empirical investigation, we provide a brief background summary of bond mutual funds and, in particular, the salient features of investor net flows into EME bond funds.

2.1 Overview of EME bond funds

Table 1 gives summary statistics on EME assets held through dedicated collective investment vehicles,[7] drawing on the Lipper database. According to Lipper, the assets under management (AUM) of dedicated EME bond funds have grown strongly over the past decade and stood at $1.3 trillion at the end of 2014 (Table 1).

Open-end funds allow investors to add or redeem investments. Exchange-traded funds (ETFs) are a form of open-end fund that is traded on exchanges. Closed-end funds, when set up, issue a fixed number of shares that are traded on secondary markets. Open-end mutual funds are much larger than closed-end funds and ETFs in terms of both the number of funds and the total amount of AUM.

Asset managers can also be divided into actively managed funds, whose allocation or investment decisions are not tied directly to a benchmark index, and passively managed funds which seek to track a benchmark index. Around 98% (74%) of EME bonds (equities) managed by collective investment vehicles have mandates to follow an active investment strategy (Table 1). That said, the share of passively managed funds including almost all ETFs has increased in recent years. Notably, owing to their low cost, ETFs have gained popularity as a vehicle to gain exposure to EME assets.

[7] Terminologies differ by country. For instance, open-end funds are called mutual funds in the United States and UCITS (undertakings for collective investment in transferable securities) in the European Union. We use the term "mutual funds" for collective investment vehicles, which include traditional open- and closed-end funds managed by asset management companies, but not hedge funds.

Types of collective investment vehicles investing in bonds and equities

As of end-2014, in billions of US dollars Table 1

	Bond funds investing in		Equity funds investing in	
	Advanced economies	Emerging market economies	Advanced economies	Emerging market economies
Total net assets (in USD billions)[1]	6,134	1,286	12,462	1,641
Fund structure (in per cent)				
Open-end mutual funds	93.84	96.68	85.91	87.01
Closed-end mutual funds	0.03	1.87	0.14	0.32
Exchange-traded funds	6.13	1.45	13.95	12.67
Investor (in per cent)				
Institutional[2]	27.73	10.94	27.79	17.77
Retail	72.27	89.06	72.21	82.23
Strategy (in per cent)				
Actively managed	86.14	98.13	68.07	74.40
Passively managed	13.86	1.87	31.93	25.60

[1] Sum of aggregate fund values. Emerging market economy bond (equity) funds include bond (equity) mutual funds and bond (equity) ETFs with geographic focus on Africa, Argentina, ASEAN, Asia excluding Japan, Asia-Pacific excluding Japan, Asia-Pacific, Baltic States, Bangladesh, Brazil, BRIC, Bulgaria, Caribbean, Chile, China, Chinese Taipei, Colombia, the Czech Republic, Eastern Europe, Egypt, Far East excluding Japan, Frontier Markets, GCC, Global Emerging Markets, Greater China, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Kuwait, Latin America, Latin America Miscellaneous, Lebanon, Malaysia, Malta, MENA, Mexico, Middle East, Morocco, Oman, Pakistan, Pan-America, Peru, the Philippines, Poland, Qatar, Romania, Russia, Singapore, Saudi Arabia, South Africa, Thailand, Tunisia, Turkey, United Arab Emirates and Vietnam. Advanced economy bond (equity) funds include bond (equity) mutual funds and bond (equity) ETFs with geographic focus on all the other regions and countries. [2] In the Lipper for Investment Management database, institutional investors are defined as funds targeting institutional investors only.

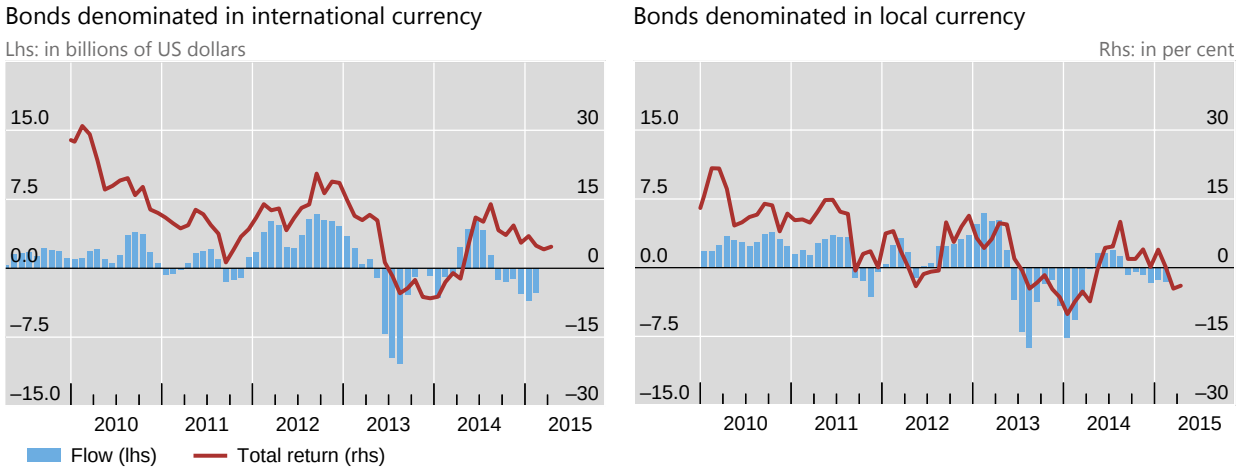
Sources: Lipper; authors' calculations.

2.2 Investor net flows

We now examine in greater detail investor net flows in a sample consisting of 368 global EME bond funds for which weekly data on investor flows are available from the EPFR database for all 113 weeks from January 2013 to February 2015. Graph 1 illustrates the positive co-movement between net flows to and returns on EME bond funds in the EPFR database.

Net flows to EME bond funds and asset performance

Graph 1



[1] Three-month moving average. [2] Total return on bonds denominated in international currency as annual change in JP Morgan EMBI Global composite total return index, and total return on bonds denominated in local currency as annual change JP Morgan GBI-EM Broad composite total return index (in US dollar terms).

Sources: EPFR; JPMorgan Chase; authors' calculations.

We examine outflows expressed as a percentage of the NAV of that fund. This is similar to a liquidity stress-testing exercise in which we can determine what amount of liquid assets (ie cash holdings) an EME bond fund should maintain to survive investor redemptions over one week or one month. We consider 174 retail investor funds and 194 institutional investor funds investing in EME bonds.[8]

The retail investor funds facing net investor outflows on average experienced weekly investor redemptions greater than 1% of their total net assets in 51 weeks out of 112 weeks in the sample period. Also, on average during the sample period, 19% of 174 retail investor funds faced 1% or more outflows compared with their individual NAV (Graph 2, left-hand panels). During the taper tantrum in June 2013, the average ratio of weekly outflows to the NAV of all funds facing outflows reached 3.3%, and 55% of 174 retail investor funds faced weekly redemptions greater than 1% of their NAV.

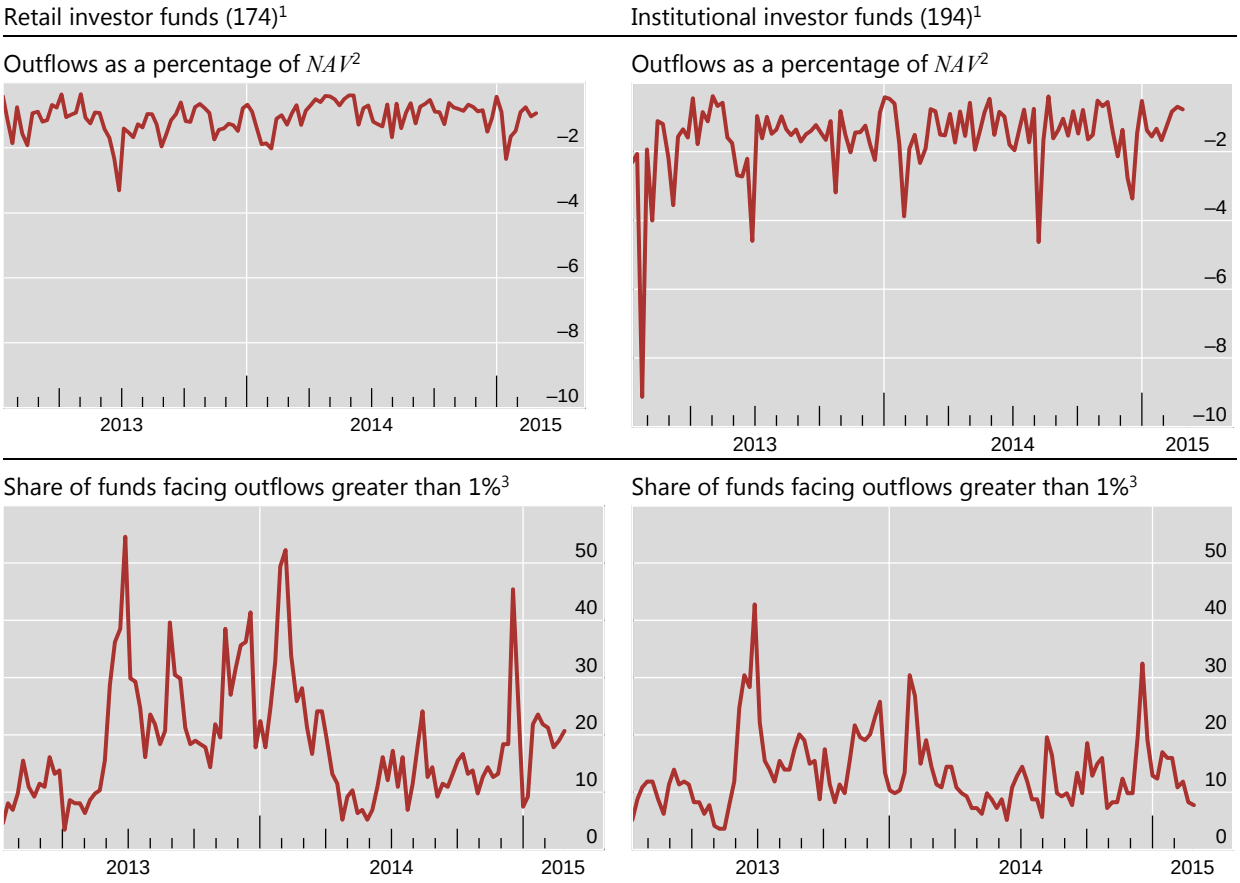
When we conduct a similar exercise for the 194 institutional investor funds, we find that the share of institutional investor funds facing sizeable outflows is smaller than that for retail investor funds both on average over the whole sample period and during severe outflow episodes (Graph 2, right-hand panels). However, the outflows as a proportion of NAV tend to be larger for institutional funds. During the taper tantrum in June 2013, outflows as proportion of NAV reached 4.6% for them.

We conducted the same exercise for AE bond funds (not reported here for reasons for space) and confirmed the hypothesis that redemptions are less severe than for EME bond funds, although the patterns are similar to those of the EME bond funds in Graph 2.

[8] In the EPFR database, institutional investor funds are defined as funds targeting institutional investors only or those with a minimum amount of $100,000 per account.

Global EME bond funds facing sizeable redemptions

January 2013 to February 2015, weekly data — Graph 2



[1] Figures in brackets represent the number of funds in each category. [2] The total amount of outflows in each week divided by the total NAV of those funds facing outflows in that week. [3] The number of funds facing outflows greater than 1% of their own NAV divided by the total number of funds in each category (174 retail funds and 194 institutional funds, respectively).

Sources: EPFR; authors' calculations.

3 Flow-driven sales and discretionary sales

We now turn to the core of the paper, examining how redemption-driven sales and discretionary sales interact. We begin with a description of our methodology in identifying discretionary sales and then show that discretionary sales tend to reinforce investor-driven sales. We go on to calculate the quantitative significance of discretionary sales. We also show that valuation losses ("residual") of a bond fund not explained by monthly changes in bond prices and exchange rate changes are positively related to sales. Finally, we examine whether investor redemptions are mitigated by higher cash holdings.

3.1 Methodology

Our approach to measuring discretionary sales of bonds is based on comparing changes in the cash holding over a time interval with the net inflows from investors during the same period.

At its simplest, consider a passive fund that holds no cash and is fully invested in bonds at all times. Then, redemptions by investors result in sales during the period of the same amount as the redemptions. In this case, all sales are driven by investor flows, and there are no discretionary sales. However, consider an alternative scenario with cash hoarding by the fund. The fund starts with no cash holding at the beginning of the period, but ends the period with a positive holding of cash, in spite of the investor redemptions. Then the positive cash holding at the end of the period can be regarded as the additional, discretionary sales undertaken by the fund, as the fund has ended up selling more than was strictly necessary to meet investor redemptions.

This simple logic can be extended to funds that start the period with positive cash holdings. Our notion of discretionary sales is to say that the fund has undertaken discretionary sales by the amount of the increase in cash holdings during the period. This is a conservative definition of discretionary sales which allows funds to hold some cash, but only deems sales to be discretionary if the cash holdings increase in spite of investor redemptions.

More formally, define F to be the net investor flows to the fund over a given interval of time, and denote by ΔC the change in the cash holding of the fund over the same interval of time. There are six possible cases we need to consider, depending on whether F is positive or negative, and on whether the cash position has increased or decreased more than F over the period, and whether the change is positive or negative. The six cases are depicted in Graph 3.

Cases 1 to 3 depict investor outflows from the fund, as F is negative. In Case 1, the change in the cash holding is negative, and is larger in absolute terms than the investor outflows. In other words, the fund manager has reduced cash holdings by more than the redemption by investors. Since the assets of the fund consist of just bonds and cash, we interpret this as the fund manager having bought additional bonds, in spite of the redemptions by investors, thus playing a stabilising role in the market. The fund manager buys bonds by depleting cash even when investors redeem their holding of bonds.

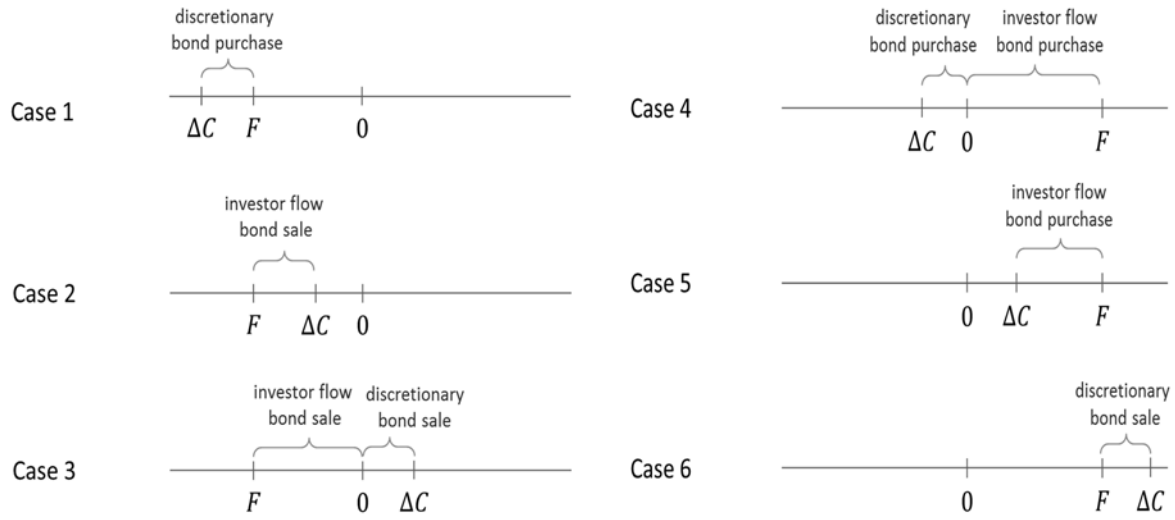
Case 2 depicts investor outflows, but where the outflows are met partly by reducing cash and partly by selling bonds. There are no discretionary sales of bonds in this instance. We deem the sale of bonds in this case to be entirely driven by investor redemptions.

Case 3 is perhaps the most interesting, and the most relevant for our investigation. It represents cash hoarding by funds: investors demand net outflows, but cash holding actually increases. In other words, the fund manager sells more bonds than is necessary to meet redemptions. The total sale of bonds is the sum of the net investor flows, which is the investor-driven sales, and the increased cash holding, which we define as the discretionary sales. As we will see below in our empirical investigation, Case 3 turns out to be the accurate description of EME bond funds during redemption episodes.

Cases 4 to 6 complete picture. They represent cases where there are positive net inflows from investors (F is positive). The interpretation of discretionary sales and purchases follow the same logic as in Cases 1 to 3, and we dispense with descriptions of each case for economy of exposition.

In this way, the logic of the comparison of net flows and changes in cash holding allows us to define for each fund, for each interval of time, quantities for investor flow-driven purchases and discretionary purchases. Table 2 gives the full

Identification of flow-driven and discretionary bond purchases and sales Graph 3



taxonomy of investor-driven and discretionary purchases according to the reasoning in the six cases in Graph 3.

When implementing our definitions, one practical complication arises from the fact that we observe snapshots of our variables only at the end of each time interval, whereas investor flows happen continuously throughout the time interval. Similarly, the fund could sell or buy at any time during the interval of time, but we would only observe the snapshots of portfolio holdings at the end of the time interval. This mismatch between observations in the data series and the underlying decisions becomes worse in practice, because the portfolio information we need is available only at the monthly frequency.

To overcome these data limitations, we proceed in two steps. First, we consider a benchmark case where all purchases and sales of bonds happen at the end of the month in frictionless competitive markets at prices reported at the end of the month. Any payments to investors of the proceeds of sales are also made at the end of the month following the sales. Meanwhile, any inflows from investors during the month are kept as cash balances until the end of the month when the investors' purchase orders are executed at the end-of-month prices.

We then take note of the NAV of the fund under this benchmark scenario. In practice, the observed NAV will deviate from this hypothetical NAV of the benchmark scenario due to departures from the assumptions of the benchmark scenario. For instance, investor flows will lead to purchases or sales during the month at prices other than the prices ruling at the end of the month. There may also be fire-sale discounts when large quantities are sold in distressed episodes in the market.

The second step in our procedure is to take note of the discrepancy between the hypothetical NAV that comes from the benchmark scenario and the observed NAV, and define a residual term that reconciles the hypothetical numbers with the observed numbers. We then keep track of the residual term, which holds interest in its own right, as it gives us a measure of the market liquidity frictions.

Taxonomy of flow-driven and discretionary bond purchases Table 2

	Condition	Flow-driven purchase	Discretionary purchase
Case 1	$\Delta C \leq F < 0$	0	$F - \Delta C$
Case 2	$F < \Delta C \leq 0$	$F - \Delta C$	0
Case 3	$F < 0 < \Delta C$	F	$-\Delta C$
Case 4	$\Delta C < 0 \leq F$	F	$-\Delta C$
Case 5	$0 \leq \Delta C < F$	$F - \Delta C$	0
Case 6	$0 \leq F < \Delta C$	0	$F - \Delta C$

In practice, the residual term turns out to be small in the context of overall flows and purchases, which gives some assurance that our two-step procedure is a good approximation of the underlying events. Nevertheless, the qualitative features of the residual are of some interest. Indeed, as we show below, the residual can be interpreted as fire-sale discounts in the way interpreted by the global game literature in bond markets (Goldstein, Jiang and Ng (2015)).

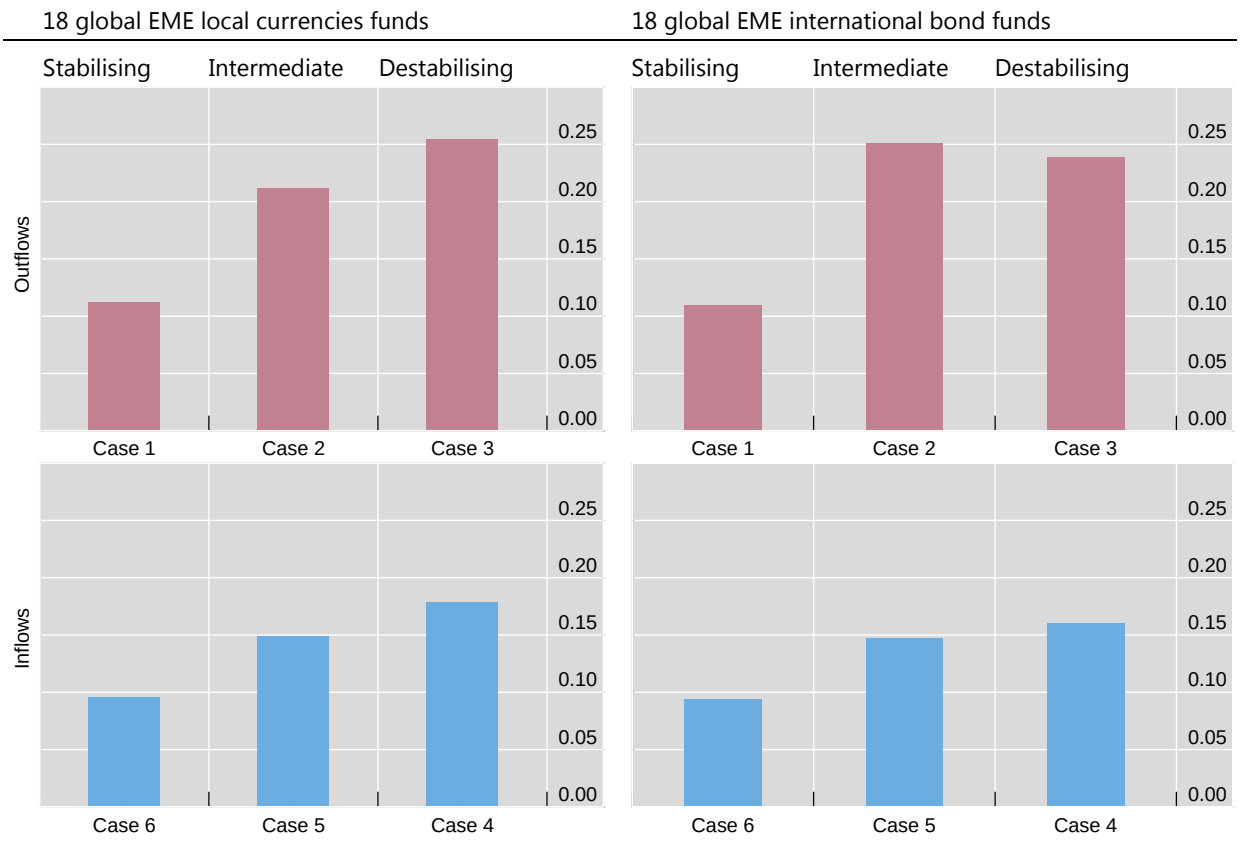
3.2 Data and measurement

The sample for our investigation of discretionary sales consists of 36 global EME funds tracked by EPFR, of which 18 are local currency bond funds (one fund for each asset management company) and 18 are international currency bond funds (holding mostly US dollar-denominated EME bonds). Appendix Table 1.1 provides a complete list of 36 EME bond funds. These funds are mostly managed by US and European asset management companies, and among the largest EME bond funds. In particular, the 18 local currency bond funds hold government bonds issued in local currency by 63 countries (including five regional groups) around the world, across all major continents, and the 18 international bond funds hold government bonds issued by 99 countries (including five regional groups) in the US dollar or other international currencies. We have monthly data on cash holdings and asset allocations as well as investor flows for all these funds. The sample period is the 18 months from January 2013 to June 2014.

Before we calculate discretionary and flow-driven purchases and sales for the sample of 18 EME local currency bond funds and 18 EME international bond funds, we record for each fund-month observation which of the six cases it falls under, and then add up all instances for the six cases and report the frequency across the six cases for the whole sample.

We are interested in the conditional distribution over the cases given the net flows. The main hypothesis of our paper is that Case 3 (flow-driven sales combined with discretionary sales) will be more frequently observed than Case 1 (discretionary purchases amidst investor redemptions), and that Case 4 (flow-driven purchases combined with discretionary purchases) will be more frequently observed than Case 6 (discretionary sales amidst positive investor inflows). Cases 3 and 4 represent destabilising or procyclical behaviour by fund managers, whereas Cases 1 and 6 represent stabilising or countercyclical trading behaviour. Graph 4 shows the frequency of each case for local currency bond funds and international bond funds separately.

Frequency of cases with stabilising/destabilising purchases and sales Graph 4



Sources: EPFR; authors' calculations.

For positive net flows, Case 4 is the most frequently observed for both local currency bond and international bond funds (Graph 4, lower panels). Conditional on negative net flows, Case 3 is most likely for local currency bonds, although Case 2 is most likely (by a close margin) in the international currency case (Graph 4, upper panels). But in any event, Cases 3 and 4 (destabilising sale or purchase of bonds by fund managers) emerge as being much more likely than Cases 1 and 6 (stabilising sale or purchase), conditional on the sign of the flows.

Now we implement the methodology for calculating discretionary and flow-driven sales as described in Section 3.1. For each month and for each fund, we decompose changes in the NAV of the 18 local currency funds and attribute them to separate components. Specifically, we apply the following procedure:

(1) Calculate the difference between the current month-end NAV of a fund and the previous month-end NAV.

(2) Subtract investor net flows during the month from the change in NAV. Investor flows are then allocated to investor flow-driven purchases and increase in cash holdings due to flows, following the definitions in Table 2.

(3) Subtract any valuation effects from currency appreciation vis-à-vis the US dollar.

(4) Subtract any bond price (in local currency) valuation changes for each country's bonds. When possible, we use the JP Morgan GBI country-level benchmark

local currency total return indices. The country-level index is available for around half of the 63 countries. For the remainder, we use the JP Morgan regional-level benchmark local currency total return indices.

(5) Calculate the change in the US dollar value of bond holdings of a fund after controlling for investor net flows, currency valuation effects and bond price valuation effects. Then add the two types of bond purchases defined in Table 2. The sum gives the hypothetical NAV of the fund under the benchmark scenario.

(6) Finally, calculate the residual term by subtracting the hypothetical NAV from the observed NAV for that month.

Illustration of the breakdown of the NAV change of a global EME bond fund — Graph 5

Graph 5 illustrates the decomposition of the monthly NAV change of a local currency bond fund. By construction, the pink bar indicating the discretionary purchase of bonds is the same as that of the decrease in cash due to discretionary purchase, indicated as the downward-pointing bar in yellow.

Using the data on monthly investor flows and changes in cash holdings for each fund under the six different cases described in Table 2, we can calculate the raw correlations between key pairs of variables in our setup. The results are reported in Tables 3 and 4. Table 3 pertains to local currency bond funds, while Table 4 is on international currency bond funds.

The key finding is in the third column of each table. The third column reports the correlation across time of the two types of bond purchases – discretionary and investor flow-driven purchases – of the fund. The correlation is positive for all but two local currency funds, and the correlation is often strongly positive.

For each fund, we can calculate the components illustrated in Graph 5. Appendix 2 shows the components for four selected EME local currency bond funds and four EME international bond funds.

Graph 6 is a time series chart for the six components of monthly changes in NAV, aggregated across 14 global EME local currency bond funds.[9] Overall, investor flow-driven purchases are the most important factor in explaining changes in the value of EME local currency bond funds. Discretionary purchases of bonds, currency valuation effects and local currency bond price changes are also important factors.

As suggested by the correlation results, we find that discretionary sales by fund managers tend to reinforce the bond sales due to investor redemptions. We also find that currency valuation effects tend to reinforce bond price declines in local currency terms. Moreover, except in April 2013, June 2013, October 2013 and April–June 2014, the FX effect was greater than the bond price effect. We return to the currency valuation effect shortly. Finally, we find that flow-driven bond purchases and currency valuation changes and bond price changes are generally positively correlated.

We can construct an analogous time series bar chart for the 18 global EME international bond funds. The decomposition of the monthly NAV change can be done as follows:

(1) Calculate the difference between a month-end NAV of a fund and the previous month-end NAV;

(2) Subtract net inflows to the fund during the month from the difference in NAV, where investor flows are further divided into "cash used for purchases (or proceeds from sales) due to flows" and "change in cash holdings due to flows" as explained above;

(3) Subtract any currency effects (ie exchange rate changes) due to a fund's holdings of other international currency-denominated EME bonds such as euro- and yen-denominated bonds;

[9] Among the 18 local currency bond funds, we do not include in this graph two funds for which the EPFR database does not provide information on country asset allocations for more than two months during the sample period, and another two funds which heavily use leverage throughout the sample period.

Correlations between investor flows, changes in cash holdings, bond purchases and residuals for 18 global EME local currency bond funds

Table 3

	Correlation between investor flows and changes in cash holdings	Correlation between investor flows and cash used for total purchases	Correlation between flow-driven purchases and discretionary purchases	Correlation between residuals and cash used for total purchases
Fund 1	0.78	0.99	0.06	0.26
Fund 2	−0.54	0.88	0.78	0.48
Fund 3	0.81	0.93	0.06	−0.23
Fund 4	0.27	0.81	−0.04	−0.15
Fund 5	0.11	0.84	0.19	−0.37
Fund 6	0.23	0.42	0.09	0.35
Fund 7	0.98	1.00	−0.44	0.16
Fund 8	0.18	0.80	0.48	−0.12
Fund 9	0.41	0.93	0.58	0.40
Fund 10	0.29	0.77	0.30	0.43
Fund 11	−0.02	0.95	0.33	−0.07
Fund 12	-0.10	0.92	0.62	0.14
Fund 13	0.61	−0.46	0.32	−0.05
Fund 14	0.03	0.83	0.55	0.02
Fund 15	−0.38	0.67	0.49	−0.23
Fund 16	0.54	0.95	0.52	0.27
Fund 17	−0.04	0.93	0.23	0.02
Fund 18	0.47	0.99	0.21	−0.21

Sources: EPFR; authors' calculations.

Correlations between investor flows, changes in cash holdings, bond purchases and residuals for 18 global EME international bond funds

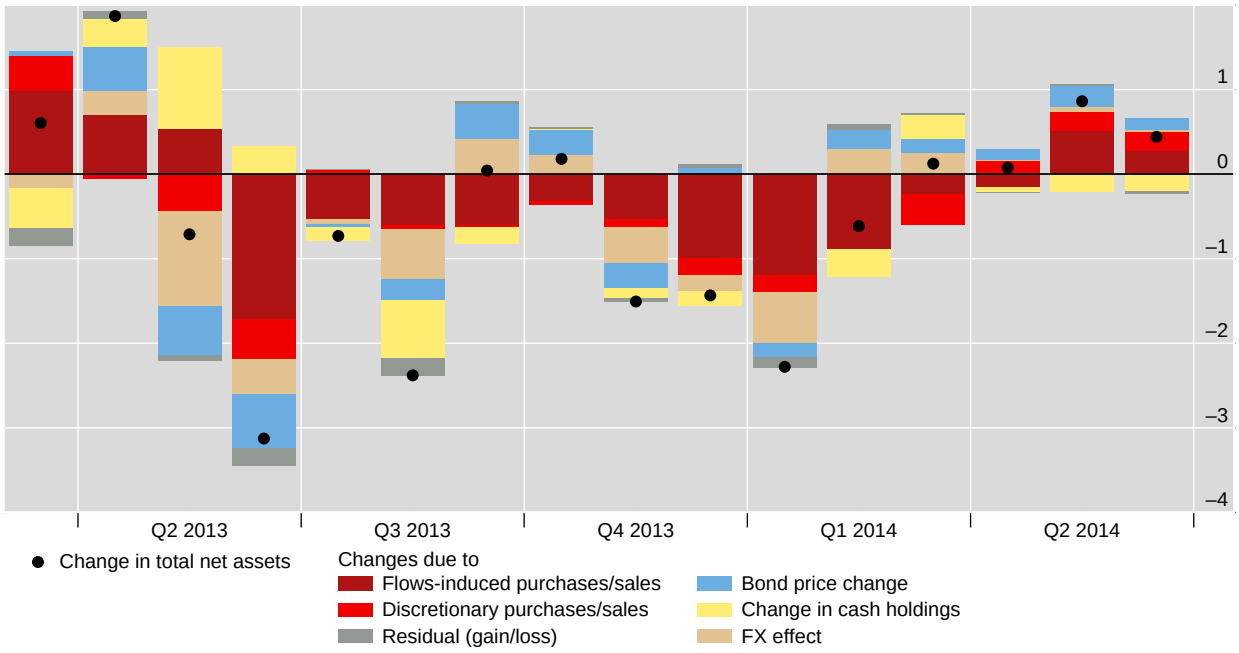
Table 4

	Correlation between investor flows and changes in cash holdings	Correlation between investor flows and cash used for total purchases	Correlation between flow-driven purchases and discretionary purchases	Correlation between residuals and cash used for total purchases
Fund 1	0.63	0.97	0.27	0.67
Fund 2	−0.61	0.94	0.72	−0.32
Fund 3	0.59	0.49	0.07	0.05
Fund 4	-0.02	0.96	0.28	−0.26
Fund 5	0.49	0.75	0.26	−0.13
Fund 6	0.06	0.90	0.21	0.40
Fund 7	−0.19	0.99	0.66	−0.02
Fund 8	0.59	0.85	0.26	0.55
Fund 9	0.23	0.74	0.28	−0.33
Fund 10	0.22	0.94	0.54	0.75
Fund 11	0.10	0.86	0.06	0.49
Fund 12	0.11	0.92	0.70	−0.12
Fund 13	0.06	0.31	0.12	−0.01
Fund 14	−0.11	0.42	0.44	0.22
Fund 15	0.86	0.12	0.02	−0.28
Fund 16	0.38	0.90	0.43	0.58
Fund 17	−0.12	0.99	0.24	−0.05
Fund 18	0.06	0.71	0.37	0.15

Sources: EPFR; authors' calculations.

Breakdown of monthly changes in net asset value

Sum over 14 global EME local currency bond funds, in billions of US dollars — Graph 6



Sources: EPFR; authors' calculations.

(4) Subtract any bond price (in US dollars) changes for each country's bonds held by a fund, where we use JP Morgan EMBI country-level benchmark US dollar total return indices for most of the 99 countries for which these indices are available, and JP Morgan regional-level benchmark US dollar total return indices for a small number of countries for which such country-level indexes are not available.

Through the above procedure (steps (1) to (4)), we obtain the change in the dollar value of bond holdings net of investor net flows, currency effects and dollar bond price effects, which gives the amount of discretionary purchases; and

(5) Finally, we calculate the residual term by subtracting the amount of cash used to purchase bonds from the amount of discretionary purchases, that is, by subtracting the hypothetical NAV from the observed NAV for that month.

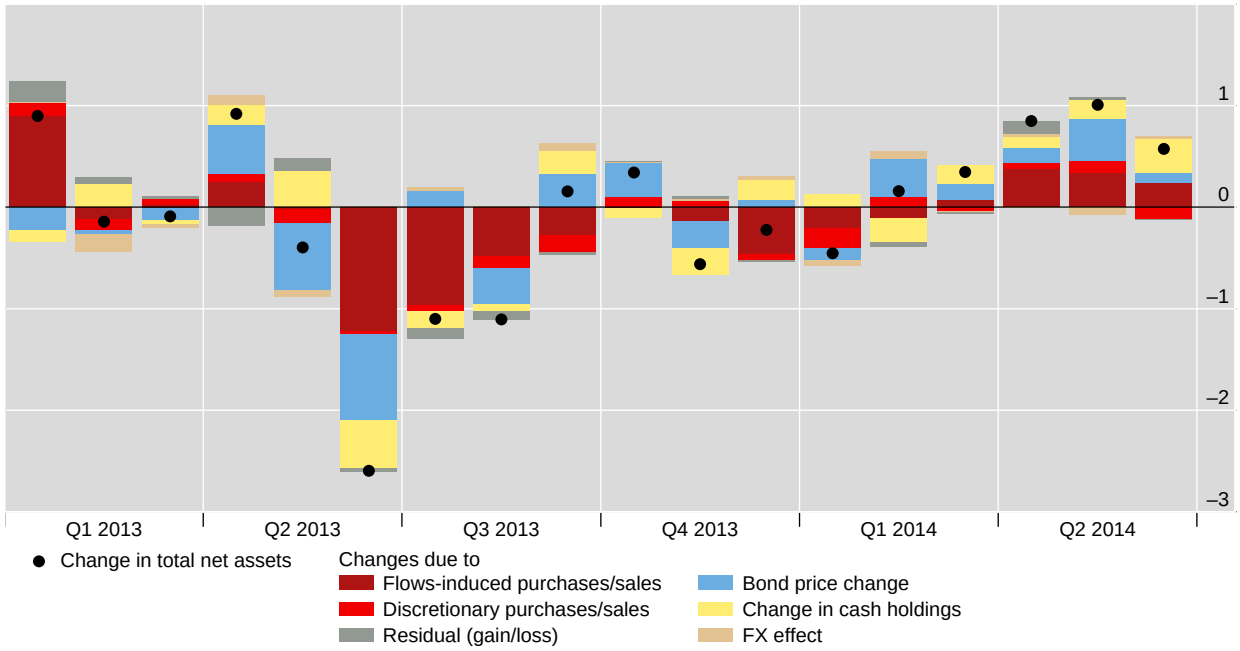
Graph 7 shows the decomposition of changes in the NAV of 16 EME international bond funds into six components.[10] Overall, flow-driven purchases and US dollar bond price changes are the most important factors. Discretionary purchases are also important in certain months. We again find that discretionary sales by fund managers tend to reinforce the bond sales due to investor redemptions. We find that US dollar bond price changes and exchange rate effects (international currencies vis-à-vis US dollar) are overall positively correlated.

[10] Among the 18 EME international bond funds, we do not include one fund for which the EPFR database does not provide information on country asset allocations for five months during the sample period, and another fund which heavily uses leverage throughout the sample period.

Breakdown of monthly changes in net asset value

Sum over 16 global EME international bond funds, in billions of US dollars

Graph 7



Sources: EPFR; authors' calculations.

3.3 Quantitative significance of discretionary sales

Having established that investor flow-driven sales and discretionary sales are positively correlated, we now turn to the question of the quantitative significance of discretionary sales. Discretionary sales reflect the hoarding of cash by asset managers during periods of market turbulence. Gauging their quantitative significance is an important precondition for an overall judgment on the market-wide liquidity impact of one-sided markets and fire sales.

We conduct a panel investigation of the quantitative impact of discretionary sales where investor flow-driven sales enter on the right-hand side, together with other variables that are known to be associated with periods when financial markets are unsettled. In particular, we examine a panel regression with fund fixed effects, where the dependent variable is the discretionary purchase of bonds by a fund in month t normalised by the NAV of the fund at the beginning of t. The main explanatory variable is the investor-driven purchase of bonds by the fund in month t also normalised by the NAV of the fund at the beginning of t. The coefficient on this variable will give us a quantitative estimate of the incremental sales due to fund manager discretion in reaction to sales necessitated by one dollar's worth of sales driven by net flows from investors. We also consider in some specifications the total net investor flows as an alternative main explanatory variable. In addition, we include explanatory variables that have been associated with periods of market turbulence such as the VIX.[11] Finally, we also include the variables $FP^{+} = \max\{0, FP\}$

[11] We also tried a variety of combinations of the lagged VIX, the six-month log difference of the US dollar index, JP Morgan EMBI Global Diversified total return index (for global EME international

and $TF^{+} = \max\{0, TF\}$ where FP denotes the investor flow-driven purchases of the fund and TF the total amount of investor net flows to the fund. These variables pick up any asymmetry in the impact of flow-driven sales or investor redemptions on discretionary sales depending on whether the sales are positive or negative.

The panel regression results under different specifications for the 18 EME international bond funds and the 18 EME local currency bond funds show that the empirical magnitude of discretionary purchases is not only statistically significant but also economically significant. First, for the 18 EME international bond funds, columns (1) and (2) of the upper panel in Table 5 show that when the flow-driven purchase increases by 1% of the NAV, the discretionary purchase increases by 0.08−0.10% of the NAV. We can say that the cash hoarding component is around 10% of investor-driven sales. The coefficient on the ratio of the total amount of net investor flows to a fund's NAV is around 0.06 (column (3), upper panel). This gives us another quantitative fix on discretionary purchases, and provides a rule of thumb on discretionary sales as a proportion of net investor flows. We also find that the coefficient on the VIX has the predicted negative sign but is statistically insignificant (columns (2) and (3)).[12]

We include an additional term to pick up any asymmetry between flow-driven purchases and flow-driven sales by EME international bond funds. We find that the coefficient is negative but statistically insignificant (columns (4) to (6) of the upper panel in Table 5). This lack of asymmetry could be interpreted as indicating the existence of risk-taking during boom times, which are unwound during downturns. Finally, it is noteworthy that the coefficients on flow-driven sales or redemptions do not vary much across different specifications (including different combination of control variables) of the regression, giving some assurance of robustness of our estimate of the elasticity of discretionary sales with respect to investor driven sales.

We conduct the same panel regression for the 18 global EME local currency bond funds, whose results are reported in the lower panel of Table 5. When the flow-driven purchase increases by 1% of the NAV, the discretionary purchase increases by 0.11−0.14% of the NAV (columns (1) and (2), lower panel, Table 5). This coefficient for local currency bond funds is generally greater than that for international bond funds. The coefficient on the total amount of net investor flows over NAV is now around 0.08, again slightly larger than that for international bond funds (column (3), lower panel). Now the coefficient on the VIX has the predicted (negative) sign. Its absolute value for local currency bond funds is approximately 10 times the coefficient for international bond funds, and thus it is strongly significant (columns (2) and (3), lower panel).[13]

bond funds), JP Morgan GBI-EM Global Diversified total return index (for global EME local currency bond funds), and the MOVE index. In this paper, we use the six-month log difference of US dollar index, similar to Feyen et al (2015) who use the six-month log difference of the US REER.

[12] The coefficients on other control variables listed in Footnote 11 have predicted signs (except JP Morgan EMBI return index) but are statistically insignificant.

[13] Again, the coefficients on other control variables in Footnote 11 have predicted signs but are statistically insignificant.

Panel regressions for discretionary purchases Table 5

18 EME international bond funds						
	(1)	(2)	(3)	(4)	(5)	(6)
Flow-driven purchases (FP)	0.083** (2.135)	0.101*** (3.142)		0.097** (1.886)	0.107** (2.219)	
$\max\{FP, 0\}$				−0.038 (−0.442)	−0.015 (−0.195)	
Total investor net flows (TF)			0.058*** (2.405)			0.079** (2.110)
$\max\{TF, 0\}$						−0.045 (−0.845)
$\Delta\ln(VIX)$		−0.222 (−0.162)	−0.360 (−0.258)		−0.237 (−0.176)	−0.364 (−0.256)
18 EME local currency bond funds						
	(1)	(2)	(3)	(4)	(5)	(6)
Flow-driven purchases (FP)	0.135*** (2.850)	0.133*** (3.332)		0.119*** (4.152)	0.113*** (3.890)	
$\max\{FP, 0\}$				0.036 (0.287)	0.041 (0.419)	
Total investor net flows (TF)			0.078** (2.257)			0.052** (2.295)
$\max\{TF, 0\}$						0.054 (0.791)
$\Delta\ln(VIX)$		−3.207*** (−2.400)	−3.453*** (−2.473)		−3.203*** (−2.400)	−3.500*** (−2.510)

Coefficients on the explanatory variables from panel regressions with fund fixed effect. Dependent and explanatory variables are normalised by the NAV of each fund at the beginning of the month, except the VIX. t-statistics in brackets are calculated from standard errors clustered at the fund level.

Sources: EPFR; authors' calculations.

When we include an additional term to pick up any asymmetry between flow-driven bond purchases and sales by EME local currency bond funds, we find that the coefficients are positive but statistically insignificant (columns (4) to (6) of the lower panel in Table 5). Finally, the coefficients on flow-driven sales, investor redemptions and the VIX vary little across different specifications (including different combination of control variables) of the regression.

3.4 Residual as a measure of the liquidity discount

We explore the properties of the residual term that reconciles the discrepancy between the hypothetical NAV from our benchmark case with the actual observed NAV of the fund. In particular, we investigate whether the residuals are positively correlated with investor flows and bond purchases for the EME bond funds. If there is a systematic relationship between the residual and total sales, a possible candidate for the explaining residual term is in terms of a liquidity discount in which the fund is forced to dispose of the underlying assets at unfavourable prices in

order to meet redemptions, or to build up a cash hoard in anticipation of further turbulence ahead.[14]

We run the following panel regressions for EME international bond funds and for EME local currency bond funds separately, using clustered standard errors at the fund level:

$$Residual_t^i = \alpha + \beta^i \cdot fund^i + \delta \cdot X_t^i + e_t^i,$$

where *Residual* and X are in US dollars and X is one of the following variables:

(1) investor flows;

(2) cash used for total purchases (or proceeds from total sales);

(3) cash used for purchases (or proceeds from sales) driven by flows; and

(4) cash used for purchases (or proceeds from sales) from fund mangers' discretionary choice.

We find a significant positive relationship between the residual and the above four variables for the 18 EME international bond funds. In particular, a 100 dollar increase in redemptions and bond sales is associated with 4−6 dollar unexplained loss (Table 6).

In contrast, we do not find a significant relationship for the 18 EME local currency bond funds. The lack of significance is also reflected in the raw correlations already reported in Table 3. For the local currency bond funds, we find that the correlation between the residual term and sales is positive for 10 funds and negative for the other eight, with the positive correlations generally larger in size than

Sensitivity of residuals (unexplained gains) to investor inflows and bond purchases for global EME international bond funds

Table 6

Sample	Explanatory variable			
	Investor flows	Cash used for total purchases (or proceeds from total sales)	Cash used for purchases (or proceeds from sales) due to flows	Cash used for discretionary purchases (or proceeds from discretionary sales)
18 funds	0.043*** (2.452)	0.039** (2.028)	0.055* (1.634)	0.037*** (4.165)
17 funds (excluding 1 fund with missing data for 5 months)	0.041*** (2.338)	0.040** (2.217)	0.054* (1.564)	0.040*** (5.488)
16 funds (excluding 1 fund with missing data for 5 months and 1 fund with heavy use of leverage)	0.047*** (3.045)	0.052* (1.619)	0.063** (1.906)	0.052 (0.477)

Coefficient on the explanatory variable from panel regressions with fund fixed effect and time fixed effect. Dependent and explanatory variables are in US dollars. *t*-statistics in brackets are calculated from standard errors clustered at the fund level.

Sources: EPFR; authors' calculations.

[14] The residual term may include measurement errors from the calculation of some components. However, if these errors are unbiased, then the results of a positive relationship between the residual and total sales would still hold.

the negative correlations (Table 3, fourth column). For 18 EME international bond funds, the correlation is positive for nine funds and negative for the other nine, with the positive correlations larger in size than the negative correlations (Table 4, fourth column).

When we consider 14 EME local currency bond funds in aggregate (Graph 6), the residual (grey bar) and the total purchase (sum of two red bars) have the same sign in six out of the 18 months and the opposite signs in seven months. Nevertheless, when the size of the residual is negative and large in absolute terms (which is likely when there are fire-sale losses), there were large bond sales in almost all months except in March 2013. The pattern is clearer for the 16 EME international bond funds in aggregate (Graph 7), where the residual (grey bar) and the total purchase (sum of two red bars) have the same sign in 12 of the 18 months.

3.5 Response of investor redemptions to cash hoarding

We provided two explanations for the positive correlation between redemption-driven sale and discretionary sale: (1) strategic incentives involved in investor redemptions and discretionary sales the interaction between these two; and (2) cash hoarding by fund managers in anticipation of future redemptions. In this section, we try to investigate whether fund managers sell bonds in anticipation of future redemptions and also whether investor redemptions respond to higher cash holdings that result from discretionary sales.

As a first step, we consider lead-lag structures between investor redemptions and discretionary sales to find out whether fund managers tend to *anticipate* redemptions and sell ahead of actual investor redemptions, or simply *react to* redemptions and sell bonds after redemptions. We construct a cross-correlogram between investor redemptions (or investor-driven sales) and discretionary sales. In particular, we first calculate for each fund the correlation between investor-driven purchases (or investor flows) in month t and discretionary purchases in month $t+j$, where j is from –3 to +3, and then calculate the average correlations across funds.

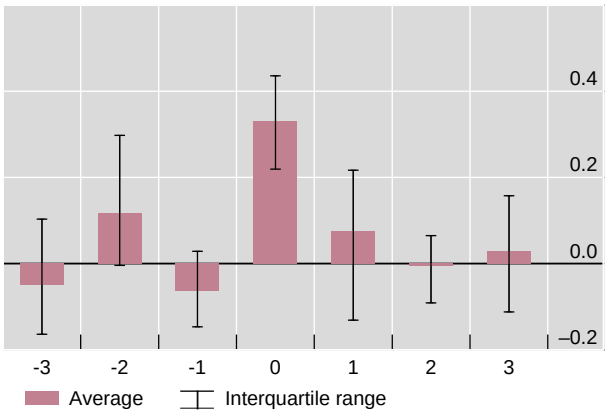
The bar chart in Graph 8 shows the cross-correlogram with error bars for the interquartile range. As we have already shown in the previous sections, we find positive contemporaneous correlations between flow-driven purchases and discretionary purchases and also between investor inflows and discretionary purchases for both EME international bond funds and EME local currency bond funds. Among all the lead-lag correlations, we observe significant positive correlation between the current-period investor flows and the previous-period discretionary purchases for local currency bond funds, which is about the same magnitude[15] as the contemporaneous correlation between the two. This result indicates that that fund managers of these funds tend to anticipate redemptions and sell bonds out of discretion ahead of actual redemptions in the next month. All the other lead-lag correlations are either close to zero or much smaller than the magnitude of the contemporaneous correlations.

[15] When we divide the sample into fund-month observations with net investor inflows (ie injections) and those with net investor outflows (ie redemptions), we find that the slightly higher average value for the lagged correlation is driven by net investor inflow observations and not by net investor outflow observations. See Appendix 3 for cross-correlograms for investor inflows only vs investor outflows only and also those for investor-driven purchases only vs sales only.

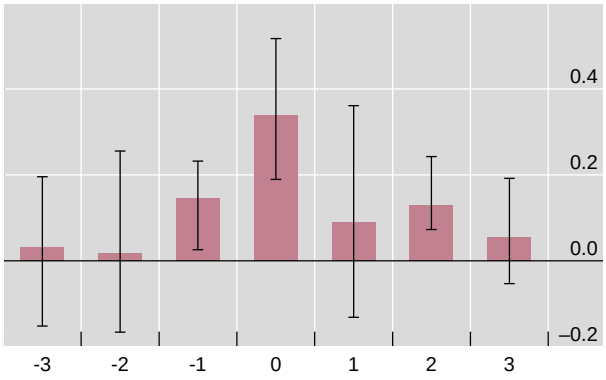
Do fund managers sell bonds before or after investor redemptions? Graph 8

Cross-correlogram between flow-driven purchases and discretionary purchases

EME international bond funds (18)

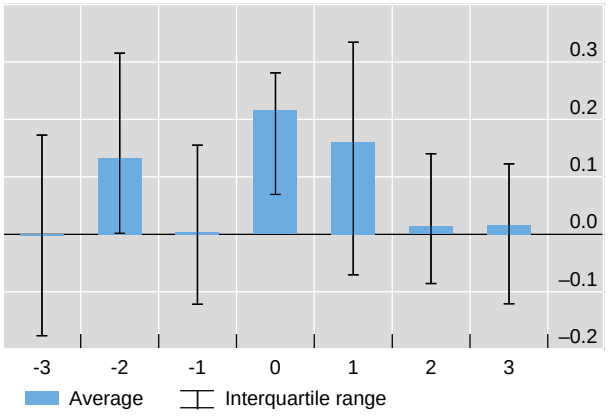


EME local currency bond funds (17)

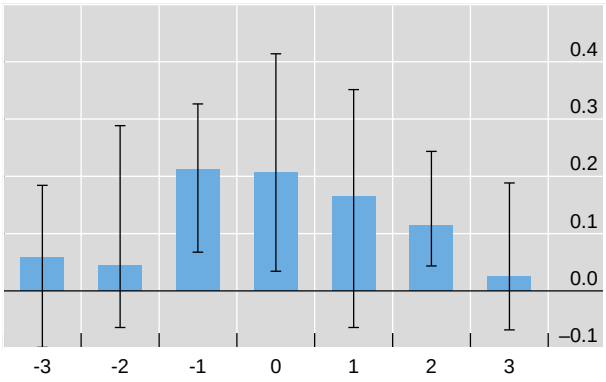


Cross-correlogram between investor inflows and discretionary purchases

EME international bond funds (18)



EME local currency bond funds (17)



Figures in brackets represent the number of funds used in the calculation in each category. The bars for 0 on the horizontal axis show the contemporaneous correlation, those for +1 the correlation between investor-driven purchases (or investor inflows) in month t and discretionary purchases in month t+1, and those for −1 the correlation between investor-driven purchases (or investor inflows) in month t and discretionary purchases in month t−1.

Sources: EPFR; authors' calculations.

In the same vein as we did in the main panel regression in Table 5, we include explanatory variables that probe the lead-lag relationship. In order to check if fund managers anticipate (or react to) investor redemptions, we use as explanatory variables the value of investor-driven purchases or investor inflows in the next (or previous) three months together with the change in the log of the VIX index, and see whether the coefficients are larger than those for the contemporaneous investor-driven sales.

In Table 7, the coefficient for the contemporaneous investor-driven sales in each category is greater than those for all the other lead or lagged investor-driven sales, and has higher statistical significance than the other coefficients in each

category.[16] These results indicate that there is no clear evidence at monthly data frequency of EME bond fund managers' anticipating investor redemptions and selling bonds ahead of actual redemptions (lower panel of Table 7). In addition, there is little evidence of these fund managers' reacting to investor redemptions and selling bonds after they observe redemptions (upper panel of Table 7). Discretionary sales are mostly contemporaneous with investor redemptions.

Do discretionary sales lead or lag investor-driven sales? Table 7

Panel regressions of discretionary purchases on investor-driven purchases in the previous months

	EME international bond funds (18)				EME local currency bond funds (18)			
	j =0	j =1	j =2	j =3	j =0	j =1	j =2	j =3
Flow-driven purchases(−j)	0.101*** (3.142)	0.012 (0.720)	0.000 (−0.020)	−0.008 (−0.613)	0.133*** (3.332)	0.017 (0.676)	0.036*** (2.490)	−0.005 (−0.252)
Investor net flows (−j)	0.058*** (2.405)	0.044** (2.109)	0.002 (0.123)	−0.010 (−0.785)	0.078*** (2.257)	0.036** (1.661)	0.027** (2.094)	−0.008 (−0.396)

Panel regressions of discretionary purchases on investor-driven purchases in the next months

	EME international bond funds (18)				EME local currency bond funds (18)			
	j =0	j =1	j =2	j =3	j =0	j =1	j =2	j =3
Flow-driven purchases(+j)	0.101*** (3.142)	−0.021* (−1.550)	0.018 (0.460)	−0.048*** (−2.823)	0.133*** (3.332)	0.050*** (2.690)	−0.046 (−0.891)	−0.036 (−0.885)
Investor net flows (+j)	0.058*** (2.405)	−0.005 (−0.377)	0.014 (0.437)	−0.037** (−2.178)	0.078*** (2.257)	0.048** (2.317)	−0.019 (−0.353)	−0.026 (−0.732)

Figures in brackets represent the number of funds used in the calculation in each category. Coefficients on each of the explanatory variables from panel regressions with fund fixed effect and the change in the log of the VIX index (whose coefficient is not reported in the table). Dependent and explanatory variables are normalised by the NAV of each fund at the beginning of the month, except the VIX variable. t-statistics in brackets are calculated from standard errors clustered at the fund level.

Sources: EPFR; authors' calculations.

Finally, we check if whether cash hoarding of the managers stems investor redemptions. This is a difficult question to address empirically, since we are interested in the counterfactual question of what would have happened had the manager not hoarded cash. Here, we run a panel regression of investor redemptions as a proportion of NAV at the beginning of the month on the following explanatory variables: (1) the average cash to NAV ratio over the last three months, (2) the increase in cash in the previous month as a proportion of NAV at the beginning of the month, (3) the percentage monthly return on a fund's bond holdings, and (4) other controls such as the VIX index.

Overall, there is little evidence that cash hoarding slows down redemptions. We find that increases in cash holdings in the current month by EME international bond funds are associated with reduced redemptions in the next month, but the coefficient on cash hoarding becomes insignificant when we additionally consider

[16] Similar results hold when we consider different sets of funds among the 18 funds in each category and also when we exclude the VIX index from the explanatory variables.

each fund's performance or the change in the VIX index (the upper-left panel of Table 8) in the current month. Moreover, when we focus on the most interesting case of cash hoarding during redemptions in the current month, the coefficient becomes insignificant (the lower-left panel). For the EME local currency bond funds, we find that the coefficient on cash hoarding in general is insignificant (the upper-right panel of Table 8). Moreover, when we specifically consider the case of cash hoarding during redemptions, the coefficient becomes positive and statistically significant, which implies that increases in cash holdings in the current month are associated with increased redemptions in the next month (the lower-right panel).

Do investor redemptions respond to cash hoarding? Table 8

Increases in cash holdings in the previous month (Cases 3, 5 and 6)

	EME international bond funds (18)				EME local currency bond funds (18)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Change in cash holdings (−1)	−0.205* (−1.468)	−0.218** (−1.661)	−0.066 (−0.446)	−0.038 (−0.265)	0.165 (0.741)	0.171 (0.820)	0.042 (0.230)	0.052 (0.265)
Average level of cash holdings(−1)		0.132 (1.195)	0.093 (0.936)	0.071 (0.724)		0.170 (1.025)	0.458** (1.671)	0.429* (1.598)
Fund returns(−1)			−0.650*** (−4.158)				−0.450*** (−3.119)	
$\Delta\ln(VIX)(-1)$				5.205** (1.987)				5.895** (2.179)

Increases in cash holdings amid investor redemptions in the previous month (Case 3)

	EME international bond funds (18)				EME local currency bond funds (18)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Change in cash holdings (−1)	−0.214 (−0.967)	−0.209 (−0.915)	−0.080 (−0.430)	−0.117 (−0.496)	0.282** (1.797)	0.282** (1.700)	−0.045 (−0.218)	0.023 (0.097)
Average level of cash holdings(−1)		0.027 (0.317)	0.055 (0.620)	−0.026 (−0.262)		0.001 (0.008)	0.084 (0.522)	0.050 (0.353)
Fund returns(−1)			−0.651*** (−4.669)				−0.348*** (−3.139)	
$\Delta\ln(VIX)(-1)$				4.074** (2.242)				2.194 (0.870)

Figures in brackets represent the number of funds used in the calculation in each category. Coefficients on the explanatory variables from panel regressions with fund fixed effect and time fixed effect except the specification including the VIX variable. Dependent variable is the amount of investor redemptions, so it takes positive value for net outflows and negative value for net inflows. Dependent and explanatory variables are normalised by the NAV of each fund at the beginning of the month, except fund returns and the VIX variable. All explanatory variables are lagged by one month. *t*-statistics in brackets are calculated from standard errors clustered at the fund level.

Sources: EPFR; authors' calculations.

4 Duration analysis

Duration is an important measure for bond investors to consider, as bonds with higher durations carry more risk and have higher price volatility than bonds with lower durations. In order to gauge potential losses to EME bond funds due to future yield changes, we calculate the duration of asset managers' EME bond holdings in US dollar terms. In other words, we estimate the percentage change in portfolio values in dollar terms for a given change in local currency bond yields. Changes in the NAV of open-end mutual funds investing EME bonds come mainly from investor flows and valuation effects.[17] In particular, when ultimate investors commit more money to (or withdraw money from) mutual funds, their NAV increases (or decreases). Also, the value of an EME bond portfolios managed by a fund manager changes when EME bond yields move up or down or when EME currencies appreciate or depreciated.

The effective duration of bond holdings is calculated as $\frac{\Delta lnV_t}{\Delta r_t}$, where V_t is the value of a bond portfolio of a fund at the end of t and r_t is bond yield at the end of t. We assume that investor flows into/out of a fund in period t+1 (that is, between the end of t and the end of t+1) are held as cash during period t+1 and invested in bonds at the end of t+1 (or at the beginning of t+2). Under this assumption, $NAV_t = cash_t + V_t$ and $NAV_{t+1} = cash_{t+1} + V_{t+1} + CF_{t+1}$, where CF_{t+1} is cash flows during t+1 and can be positive (additions) or negative (redemptions).

We collect monthly data on the NAV and CF of global EME local currency bond funds from the EPFR database from January 2012 to February 2015.[18] We find 63 global EME local currency bond funds for which the EPFR database has information on both NAV and CF every month during the same period. Among the 63 funds, 33 funds use JP Morgan GBI-EM Global Diversified index as their benchmark.[19] We focus on these 33 funds using the same benchmark in our analysis to minimise approximation errors in calculating the duration.[20] Appendix Table 1.2 provides the list of 33 funds. Among the 33 funds, the EPFR database provides information on

17 This exercise is to gauge the impact of yield changes on the value of bond holdings of a fund, so we do not consider additional purchases and sales. However, to be precise, when we calculate ΔlnV_t, we need to exclude "residuals". Here, we ignore residuals because we cannot calculate them for most of the funds in the sample and they are of negligible size.

18 We can conduct the same analysis on regional bond funds such as Asia ex-Japan funds, Latin America funds and emerging Europe funds, as well as country-level bond funds such as Brazil local currency bond funds and Korea local currency bond funds, by using appropriate bond yields and exchange rates. In this paper, we focus on global EME bond funds since they consist of the supermajority of EME bond funds in terms of NAV.

19 In the EPFR database, 35 funds using JP Morgan GBI-EM Global Diversified index have complete information on NAV and flows for all months during the sample period. However, one of the 35 funds has an observation in which the fund's NAV increased more than 70% over a month in both US dollar and local currency terms and at the same time the benchmark yield increased by about 0.3 percentage points. Also, another fund has an observation in which the fund's NAV increased around 65% over a month in both US dollar and local currency terms and at the same time the benchmark yield decreased by less than 0.1 percentage points. Since these observations are highly unlikely to occur owing to bond price changes, we do not consider these two funds in the analysis.

20 Here, we focus on bond funds investing in EME government bonds, so that we don't have to worry about fluctuations in the credit risk component in EME corporate bond yields.

the weight for cash holdings of 14 funds. We calculate the average value of the weight for cash holdings,[21] and apply that to the other funds in the sample.

In the EPFR database, the NVA and CF of local currency bond funds are reported in US dollars, hence the value of a bond portfolio V_t is also in US dollars. We can calculate the value V_t in local currency terms by using an appropriate exchange rate (US dollars/local currency). It should be noted that when we define $V_t^{USD} = e_t V_t^{LC}$, where e_t is the exchange rate in dollars per unit of local currency at t and V_t^{LC} is the value of local currency bond portfolio at t, we have $lnV_t^{USD} = \ln[e_t V_t^{LC}] = \ln(e_t) + \ln(V_t^{LC})$, and thus $\Delta \ln[e_t V_t^{LC}] = \Delta \ln(e_t) + \Delta \ln(V_t^{LC})$. We define $\frac{\Delta lnV_t^{USD}}{\Delta r_t}$ as US dollar duration, which is the sum of the exchange rate effect $\frac{\Delta \ln(e_t)}{\Delta r_t}$ and local currency duration $\frac{\Delta lnV_t^{LC}}{\Delta r_t}$. Since we do not have data for their country allocation weights, when we calculate the exchange rate effect for the 33 funds, we use the weighted average exchange rate calculated by the portfolio allocation weights of their benchmark bond index, JP Morgan GBI-EM Global Diversified index.

Appendix Graph 4.1 shows scatter charts of the change in the mark-to-market value of each fund to the change in the yield of JP Morgan GBI-EM Global Diversified index. The slope of the red line shows US dollar duration, while that of the blue line local currency duration for each of the 33 funds. The charts in Appendix Graph 4.1 show that no fund significantly differs from others (that is, no strong or consistent outperformer).

In order to calculate the duration more accurately, we run the following simple panel regression:

$$\Delta lnV_{it} = \alpha + \beta_i fund_i + \delta \Delta r_t + \varepsilon_{it},$$

where V_{it} is the value of a bond portfolio of a fund i at time t, r_t is the bond yield at the end of t and $fund_i$ is fund fixed effect. We use an OLS regression but calculate clustered standard errors by funds, following the recommendation of Petersen (2009).[22]

The results from simple panel regression analysis on the 33 funds with fund fixed effects summarised in Table 9 show that (i) US dollar duration of the 33 funds during the whole sample is around 9.6, meaning that, when the average EME local currency bond yield increases by 1 percentage point, the portfolio value in US dollar of the bond funds decreases on average by 9.6%; (ii) US dollar duration (9.6) is much larger than local currency duration (5.2), indicating that when local currency bond yields increase, the depreciation of EME currencies tend to be sizeable and thus generate additional losses to the funds, and (iii) US dollar duration has decreased substantially over the past three years, while local currency duration has slightly increased at the same time, implying that these funds' sensitivity to exchange rate changes has decreased over the period.

[21] When we calculate the average, we do not include three funds which have large negative values for cash holdings throughout the sample period due to their use of leverage (ie derivatives written on assets held by the fund). This is consistent with the evidence that only a small number of large funds investing in EME bonds actively use leverage to boost their returns, while the majority of funds do not use leverage.

[22] We also calculated standard errors without clustering, but the results are again significant.

Among the 63 global EME local currency bond funds, the EPFR database provides information on cash holdings and country-by-country asset allocation for every month during the sample period for 10 funds.[23] Among them, nine funds use the JP Morgan GBI-EM Global Diversified index as their benchmark, and one fund the JP Morgan GBI-EM Broad Diversified index. For the 10 funds, we have complete information on cash holdings and country-by-country bond holdings. Therefore, we can calculate the cash holding changes and currency effects more accurately for the 10 funds than for the previous 33 funds. Appendix Table 1.3 provides the list of 10 funds.

The estimation results for the 10 funds are also presented in Table 9. Overall, both the US dollar and local currency durations of the 10 funds are similar in magnitude to those of the 33 funds. Also, the US dollar duration of the 10 funds has decreased over the past three years. However, unlike the local currency duration calculated for the 33 funds, the local currency duration of the 10 funds has decreased over time.

Estimates of the duration of global EME local currency bond funds Table 9

Sample	Duration in	Period			
		February 2012 – February 2015	February 2012 – February 2013	March 2013 – February 2014	March 2014 – February 2015
33 funds with data on NAV and flows available and using JP Morgan GBI-EM Global Diversified index as benchmark	US dollar	9.58*** (56.74)	12.77*** (23.84)	11.12*** (62.15)	7.09*** (31.96)
	Local currency	5.21*** (32.60)	3.84*** (7.46)	5.43*** (30.86)	5.16*** (24.38)
10 funds with data on NAV, flows and asset allocation available and using JP Morgan GBI-EM Global Diversified index as benchmark	US dollar	9.93*** (21.58)	12.51*** (11.85)	11.51*** (24.41)	7.83*** (15.16)
	Local currency	5.47*** (12.50)	6.11*** (7.10)	5.54*** (12.58)	4.88*** (9.36)
JP Morgan GBI-EM Global Diversified index	US dollar	9.31*** (7.38)	13.85*** (3.32)	10.63*** (10.85)	6.86*** (2.68)
	Local currency	4.85*** (60.71)	4.66*** (27.90)	4.87*** (45.24)	4.94*** (27.19)

t-statistics in brackets are calculated from standard errors clustered at the fund level.

Sources: EPFR; authors' calculations.

[23] In the EPFR database, 11 funds have complete information on NAV, flows and asset allocation for all months during the sample period. However, one of the 11 funds has an observation in which the fund's NAV increased more than 180% over a month in both US dollar and local currency terms and at the same time the benchmark yield increased by less than 0.1 percentage points. Since this is highly unlikely to occur owing to bond price changes, we do not consider this fund in the analysis.

We also compare the duration of the actively managed bond funds using the JP Morgan GBI-EM Global Diversified index as their benchmark with the duration of the benchmark index itself (or a hypothetical passively managed bond fund indexed to the same benchmark). The results in Table 9 show that the benchmark has a lower duration than the actively managed funds.

We conduct a similar exercise for global EME international bond funds. In particular, we first collect monthly data on the NAV and CF of global EME international bond funds from the EPFR database from January 2012 to February 2015. We find 100 global EME international bond funds for which the EPFR database has information on both NAV and CF every month during the same period. Among the 100 funds, 31 funds use JP Morgan EMBI Global Diversified index as their benchmark.[24] We focus on these 31 funds using the same benchmark in our analysis to minimise approximation errors in calculating the duration.[25] Appendix Table 1.4 provides the list of 31 funds.

In the EPFR database, the NAV and CF of international bond funds are reported in US dollars, hence the value of a bond portfolio V_t is also in US dollars. However, the portfolio of international bond funds includes euro-denominated bonds and yen-denominated funds in addition to US dollar-denominated bonds. Therefore, we can calculate the value of bond funds V_t in the currency of bond denomination by subtracting the increase in the portfolio value due to changes in the exchange rate (US dollars/denomination currency). Similar to what we did for local currency bond funds, we can break down the US dollar duration $\frac{\Delta ln V_t^{USD}}{\Delta r_t}$ into the exchange rate effect $\frac{\Delta \ln(e_t)}{\Delta r_t}$ and the duration in the currency of bond denomination $\frac{\Delta ln V_t^{DC}}{\Delta r_t}$. The EPFR database provides data on the exchange rate effect for all 31 funds.

Appendix Graph 4.2 shows scatter charts of the change in the mark-to-market value of each fund to the change in the yield of JP Morgan EMBI Global Diversified index. Again, the slope of the red line shows US dollar duration, while that of the blue line shows the duration in the currency of bond denomination for each of the 31 funds. The charts in Appendix Graph 4.2 show that no fund significantly differs from others (ie no strong or consistent outperformer).

In order to calculate the duration more accurately, we run the same panel regression as we do for local currency bond funds. We use an OLS regression but calculate clustered standard errors by funds.

The results from a simple panel regression analysis on the 31 funds with fund fixed effects summarised in Table 10 show that (i) US dollar duration of the 31 funds during the whole sample is around 8.6, meaning that, when the average EME local

[24] In the EPFR database, 33 funds using JP Morgan EMBI Global Diversified index have complete information on NAV and flows for all months during the sample period. However, one of the 33 funds has an observation in which the fund's NAV increased more than 50% over a month in both US dollar and the currency of bond denomination and at the same time the benchmark yield increased by about 0.7 percentage points. Also, another fund has an observation in which the fund's NAV increased almost 100% over a month in both US dollar and the currency of bond denomination and at the same time the benchmark yield decreased by about 0.2 percentage points. Since these observations are highly unlikely to occur owing to bond price changes, we do not consider these two funds in the analysis.

[25] Here, we focus on bond funds investing in EME international currency government bonds.

currency bond yield increases by 1 percentage point, the portfolio value in US dollar of the bond funds decreases on average by 8.6%; (ii) US dollar duration (8.6%) is slightly larger than local currency duration (7.3%), indicating that when the yield of EME international bonds increases, the depreciation of other international currencies against US dollars tends to generate relatively small amount of losses to the funds in addition to the decrease in the bond price in the currency of bond denomination; and (iii) the duration of EME international bond funds has increased over the past two years in both US dollars and the currency of bond denomination, implying that these funds have increased the average maturity of their holdings of international bonds.

We also compare the duration of the actively managed bond funds using JP Morgan EMBI Global Diversified index as their benchmark with the duration of the benchmark index itself (or a hypothetical passively managed bond fund indexed to the same benchmark). The results in Table 10 show that overall the benchmark has a slightly lower level of duration than the actively managed funds.

Finally, we extend the above analysis to calculate the impact of changes in US bond yields on the valuation of EME bond holdings of asset managers, which we can view as a proxy for the impact of changes in the US monetary policy on EME bond funds. In particular, we first calculate the sensitivity of two JP Morgan indices used in the above duration analyses to the yield of 10-year US Treasuries over the period of February 2012 to February 2015. Then, we multiply this value to the duration values presented in Tables 9 and 10 to obtain an estimate of potential losses to EME bond funds due to changes in US government bond yields during a specific period.

Table 11 shows that during the period from February 2012 to February 2015, a 1 percentage point increase in US 10-year Treasury yield is associated with a 72 basis point increase in the JP Morgan GBI-EM Global Diversified index yield and a 48 basis point increase in the JP Morgan EMBI Global Diversified index yield. When we consider subperiods, we find that during the period from February 2012 to February 2013, EME bond yields were insensitive to changes in the US 10-year Treasury yield.

Estimates of the duration of global EME international bond funds — Table 10

Sample	Duration in	Period			
		February 2012 – February 2015	February 2012 – February 2013	March 2013 – February 2014	March 2014 – February 2015
31 funds with data on NAV, flows and the FX effect available and using JP Morgan EMBI Global Diversified index as benchmark	US dollar	8.61*** (18.61)	10.31*** (13.24)	7.84*** (20.73)	8.73*** (6.32)
	The currency of bond denomination	7.30*** (17.16)	7.99*** (11.75)	6.68*** (17.57)	7.19*** (5.55)
JP Morgan EMBI Global Diversified index	US dollar	7.82*** (56.00)	7.88*** (30.80)	7.60*** (65.00)	8.47*** (19.45)

t-statistics in brackets are calculated from standard errors clustered at the fund level.

Sources: EPFR; authors' calculations.

However, from March 2013 to February 2014, a 1 percentage point increase in US 10-year Treasury yield was associated with an 82 basis point increase in the JP Morgan GBI-EM Global Diversified index yield and a 96 basis point increase in the JP Morgan EMBI Global Diversified index yield. Considering that this subperiod included the taper tantrum triggered by a rapid increase in US Treasury yields, a large increase in US bond yields in the future could have a strong impact on EME bond yields, which in turn generates losses to EME bond funds. Finally, during the period of March 2014 to February 2015, a 1 percentage-point increase in US 10-year Treasury yield was associated with a 93 basis point increase in the JP Morgan GBI-EM Global Diversified index yield, but a 21 basis point increase in the JP Morgan EMBI Global Diversified index yield.

EME benchmark bond yields and US government bond yield — Table 11

US bond yield	EME bond yield	Variables in	Period			
			February 2012 – February 2015	February 2012 – February 2013	March 2013 – February 2014	March 2014 – February 2015
10-year Treasury	JP Morgan GBI-EM Global Diversified	Level	0.96*** (8.61)	0.40 (0.79)	1.43*** (7.90)	0.89*** (8.71)
		Change	0.72*** (4.18)	0.07 (0.28)	0.82** (2.31)	0.93*** (4.40)
	JP Morgan EMBI Global Diversified	Level	0.76*** (5.58)	0.59 (0.98)	1.20*** (8.41)	-0.27 (-1.36)
		Change	0.48** (2.38)	-0.07 (-0.19)	0.97** (2.64)	0.21 (0.76)

t-statistics in brackets. Simple OLS regression on monthly data using month-end yields.

Sources: JPMorgan Chase; authors' calculations.

5 Conclusion

In this paper, we have investigated the potential for large-scale market fluctuations in EME bond values due to concerted selling by asset managers. In particular, we find positive correlation between investor flow-driven sales and fund managers' discretionary sales for EME bond funds and the significant empirical magnitude of discretionary sales. In addition, we provide evidence that a large share of EME bond funds have often experienced sizeable redemptions, especially during the period of EME bond market turbulence.

These factors can increase the correlation in the behaviour of asset managers and, under certain conditions, raise the potential for one-sided bond markets in EMEs. Indeed, during the past two years, investor flows to asset managers and EME bond prices reinforced each other's movements (Miyajima and Shim (2014)). Finally, duration analysis shows that a 1 percentage point increase in the local currency yield of local currency bonds is associated with a 10% decline in the dollar value of bond holdings by EME local currency bond funds.

The possibility that asset managers and their ultimate investors might destabilise EME bond markets is obviously highly relevant for policymakers. The current prudential regulation of the asset management industry mainly focuses on microprudential and consumer protection aspects and does not really address any issues that give rise to the procyclicality of investor flows and asset prices.

An important question is how far regulatory policies can help mitigate some of these risks. The current macroprudential policy tools are designed largely to deal with the banking sector's leverage and funding liquidity risks, not to deal with market liquidity risks associated with asset managers. Generally speaking, the prudential regulation of the asset management industry remains at a formative stage. Understanding various types of externality arising from the activities and behaviour of asset managers and applying macroprudential perspectives would be an important first step towards monitoring vulnerabilities created by asset managers and designing an effective policy response.

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Appendix 1: List of bond funds used for analyses in Sections 3 and 4

Appendix Table 1.1: List of 36 bond funds used for the analysis of flow-driven and discretionary sales

Global EME international bond funds (18)	Benchmark
Aberdeen Emerging Markets Bond Fund	JPM EMBI Global Diversified
Ashmore SICAV Emerging Markets Debt Fund	JPM EMBI Global Diversified
Aviva Investors - Emerging Markets Bond Fund	JPM EMBI Global
Berenberg Emerging Markets Bond Selection	JPM EMBI+
BlackRock Global Funds Emerging Markets Bond Fund	JPM EMBI Global Diversified
BNY Mellon Compass Fund Global Emerging Markets Bond Fund	JPM EMBI Global Diversified
DoubleLine Emerging Markets Fixed Income Fund	JPM EMBI Global Diversified
Federated Emerging Market Debt Fund	JPM EMBI Global
Goldman Sachs Emerging Markets Debt Fund	JPM EMBI Global Diversified
Invesco Emerging Markets Bond Fund	JPM EMBI Global Diversified
ISI Emerging Market Bonds Fund	JPM EMBI Global Diversified
JPMorgan Funds - Emerging Markets Bond Fund	JPM EMBI Global Diversified
Morgan Stanley Emerging Markets Debt Fund, Inc.	JPM EMBI Global
PIMCO Emerging Markets Bond Fund	JPM EMBI Global
Pioneer Funds - Emerging Markets Bond	JPM EMBI Global Diversified
TCW Emerging Markets Income Fund	JPM EMBI Global Diversified
Threadneedle Emerging Market Bond Fund	JPM EMBI Global
Universal Institutional Funds, Inc. - Emerging Markets Debt Portfolio	JPM EMBI Global
Global EME local currency bond funds (18)	**Benchmark**
Aberdeen Emerging Markets Debt Local Currency Fund	JPM GBI-EM Global Diversified
Ashmore SICAV Emerging Markets Local Currency Bond Fund	JPM GBI-EM Global Diversified
Aviva Investors - Emerging Markets Local Currency Bond Fund	JPM GBI-EM Global Diversified
Baillie Gifford Emerging Markets Bond Fund	JPM GBI-EM Global Diversified
Baring IF Emerging Markets Debt Local Currency Fund	JPM GBI-EM Global Diversified
BlackRock Global Funds Emerging Markets Local Currency Bond Fund	JPM GBI-EM Global Diversified
BNP Paribas L1 Bond World Emerging Local	JPM GBI-EM Global Diversified
Goldman Sachs Local Emerging Markets Debt Fund	JPM GBI-EM Global Diversified
Invesco Emerging Local Currencies Debt Fund	JPM GBI-EM Global Diversified
Investec GSF Emerging Markets Local Currency Debt Fund	JPM GBI-EM Global Diversified
ISI Emerging Market Local Currency Bonds Fund	JPM GBI-EM Global Diversified
JPMorgan Funds - Emerging Markets Local Currency Debt Fund	JPM GBI-EM Global Diversified
Morgan Stanley Emerging Markets Domestic Debt Fund	JPM GBI-EM Global Diversified
Pictet – Emerging Local Currency Debt	JPM GBI-EM Global Diversified
PIMCO Emerging Local Bond Fund	JPM GBI-EM Global Diversified
TCW Emerging Markets Local Currency Income Fund	JPM GBI-EM Global Diversified
Threadneedle Emerging Market Local Fund	JPM GBI-EM Global Diversified
WisdomTree Emerging Markets Local Debt Fund	JPM GBI-EM Global Diversified

Appendix Table 1.2: List of 33 global EME local currency bond funds used for duration analysis

Aberdeen Emerging Markets Debt Local Currency Fund
Aberdeen Global - Emerging Markets Local Currency Bond
Ashmore SICAV Emerging Markets Local Currency Bond Fund
BankInvest Hojrentelande lokalvaluta
Baring IF Emerging Markets Debt Local Currency Fund
BlackRock Global Funds Emerging Markets Local Currency Bond Fund
BNY Mellon Emerging Markets Debt Local Currency Fund
Eaton Vance Emerging Markets Local Income Fund
Goldman Sachs Growth & Emerging Markets Debt Local Portfolio
Goldman Sachs Local Emerging Markets Debt Fund
Invesco Emerging Market Local Currency Debt Fund
Investec GSF Emerging Markets Local Currency Debt Fund
Investec GSF Emerging Markets Local Currency Dynamic Debt Fund
JPMorgan Funds - Emerging Markets Local Currency Debt Fund
Lazard GIF Emerging Markets Local Debt Fund
LO Funds - Emerging Local Currency Bond Fundamental
MFS Emerging Markets Debt Local Currency Fund
MFS Investment Funds - EM Local Currency Debt Fund
MFS Meridian Funds - EM Debt Local Currency Fund
Morgan Stanley Emerging Markets Domestic Debt Fund
Morgan Stanley Investment Funds - Emerging Markets Domestic Debt
Natixis Institutional Funds (Lux) Loomis Sayles Emerging Debt & Currencies Fund
Payden Emerging Markets Local Bond Fund
PIMCO Emerging Local Bond Fund
PIMCO GIS Emerging Local Bond Fund
PineBridge Global Emerging Markets Local Currency Bond Fund
Prudential Emerging Markets Debt Local Currency Fund
T Rowe Price Emerging Markets Local Currency Bond Fund
T Rowe Price SICAV Emerging Local Markets Bond Fund
TCW Emerging Markets Local Currency Income Fund
The Hartford Emerging Markets Local Debt Fund
Threadneedle Emerging Market Local Fund
WisdomTree Emerging Markets Local Debt Fund

Appendix Table 1.3: List of 10 global EME local currency bond funds used for duration analysis

Fund name	Benchmark
Aberdeen Emerging Markets Debt Local Currency Fund	JPM GBI-EM Global Diversified
BlackRock Global Funds Emerging Markets Local Currency Bond Fund	JPM GBI-EM Global Diversified
Invesco Emerging Local Currencies Debt Fund	JPM GBI-EM Global Diversified
Investec GSF Emerging Markets Local Currency Debt Fund	JPM GBI-EM Global Diversified
ISI Emerging Market Local Currency Bonds Fund	JPM GBI-EM Broad Diversified
JPMorgan Funds - Emerging Markets Local Currency Debt Fund	JPM GBI-EM Global Diversified
Morgan Stanley Emerging Markets Domestic Debt Fund	JPM GBI-EM Global Diversified
PIMCO Emerging Local Bond Fund	JPM GBI-EM Global Diversified
TCW Emerging Markets Local Currency Income Fund	JPM GBI-EM Global Diversified
Threadneedle Emerging Market Local Fund	JPM GBI-EM Global Diversified

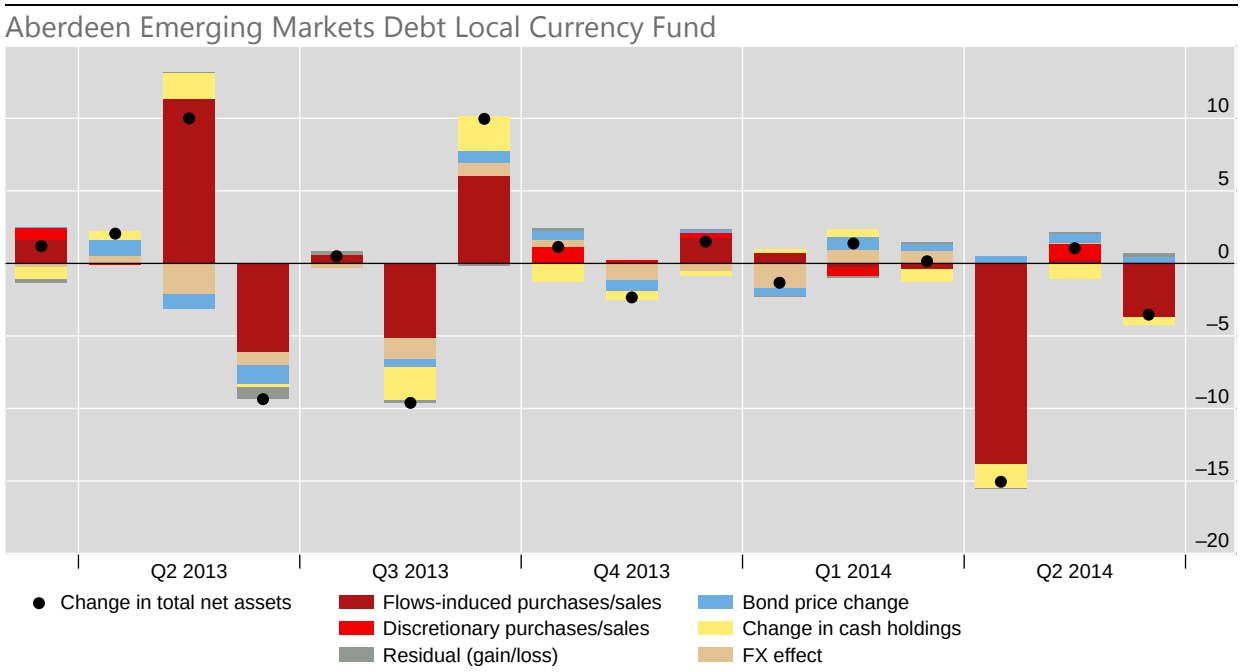
Appendix Table 1.4: List of 31 global EME international bond funds used for duration analysis

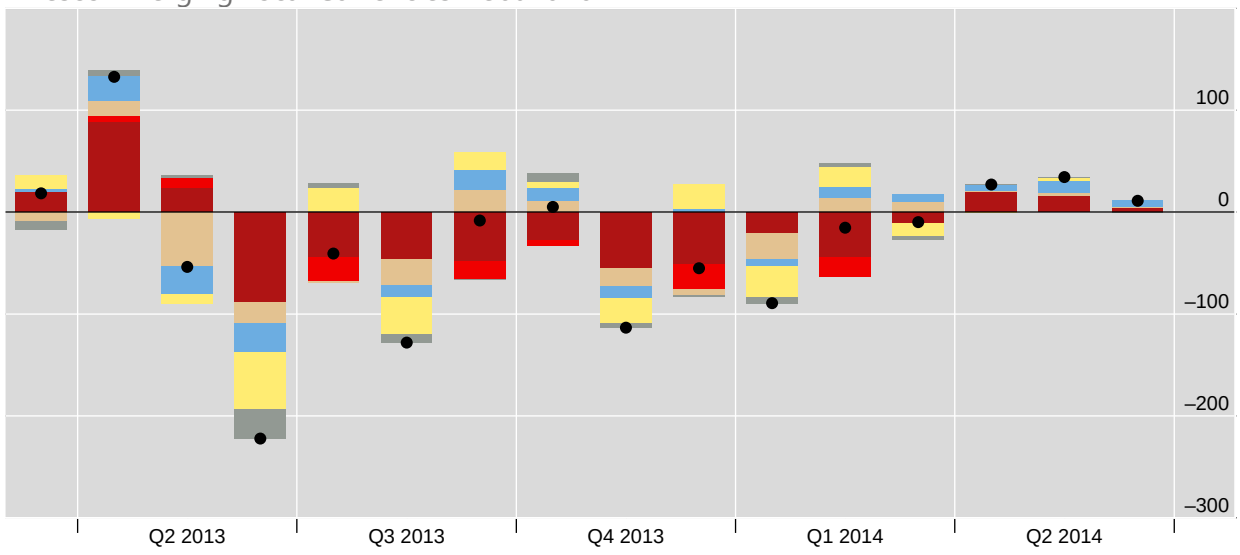
Aberdeen Global - Select Emerging Markets Bond Fund
Ashmore Emerging Markets Liquid Investment Portfolio
Ashmore SICAV Emerging Markets Debt Fund
AXA World Funds - Global Emerging Markets Bond
BlackRock Global Funds Emerging Markets Bond Fund
BNY Mellon Compass Fund Global Emerging Markets Bond Fund
DB Advisors Invest Emerging Market IG Sovereign Debt
DB Advisors Invest Emerging Market Sovereign Debt
DoubleLine Emerging Markets Fixed Income Fund
DWS Emerging Sovereign Bond Master Fund
First State Emerging Markets Bond Fund
First State GUF Emerging Markets Bond Fund
Goldman Sachs Emerging Markets Debt Fund
Goldman Sachs Growth & Emerging Markets Debt Portfolio
Henderson Institutional Emerging Market Debt Absolute Return Fund
ING (L) Renta Fund Emerging Markets Debt (Hard Currency)
Invesco Emerging Markets Bond Fund
Investec GSF Emerging Markets Hard Currency Debt Fund
ISI Emerging Market Bonds Fund
JPMorgan Funds - Emerging Markets Bond Fund
JPMorgan Funds - Emerging Markets Debt Fund
Jyske Invest Emerging Market Bonds
Jyske Invest Emerging Market Bonds (Euro)
Lazard GIF Emerging Markets Bond Fund
Payden Global Emerging Markets Bond Fund
PineBridge Global Emerging Markets Bond Fund
Pioneer Funds - Emerging Markets Bond
Raiffeisen Emerging Markets Bonds
T Rowe Price Institutional Emerging Markets Bond Fund
T Rowe Price SICAV Global Emerging Markets Bond Fund
TCW Emerging Markets Income Fund

Appendix 2: Six components of changes in the *NAV* of individual funds

Breakdown of monthly changes in the net asset value of individual funds

Global EME local currency bond funds, in millions of US dollars — Appendix Graph 2.1



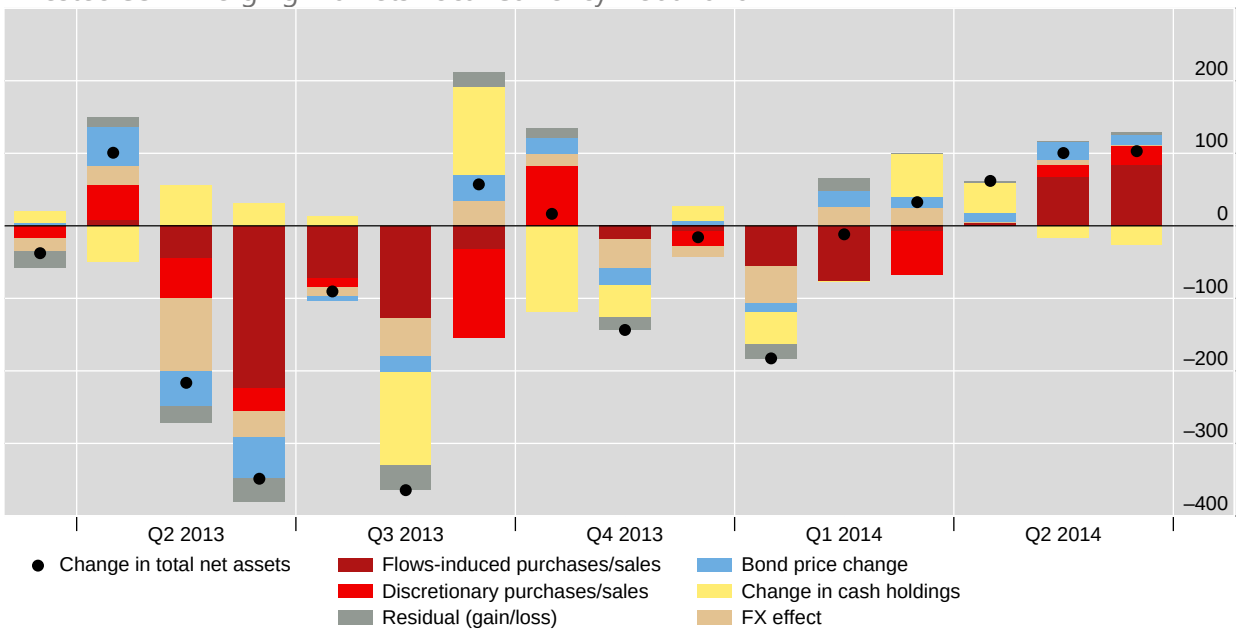


Sources: EPFR; authors' calculations.

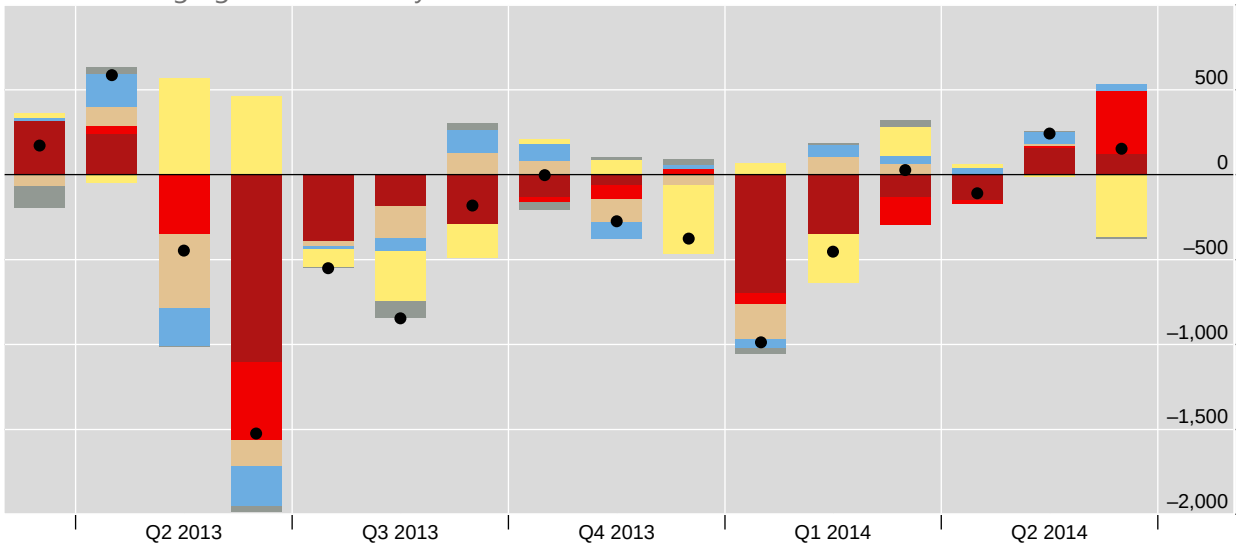
Breakdown of monthly changes in the net asset value of individual funds (continued)

Global EME local currency bond funds, in millions of US dollars — Appendix Graph 2.1

Investec GSF Emerging Markets Local Currency Debt Fund



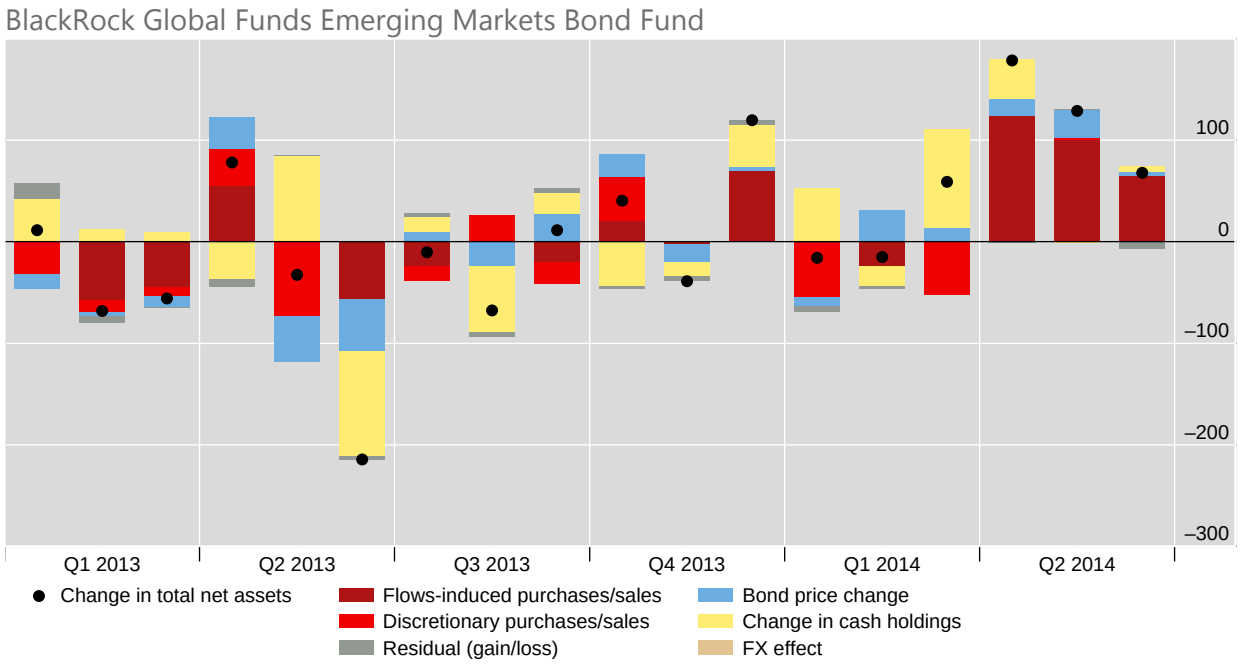
Pictet – Emerging Local Currency Debt

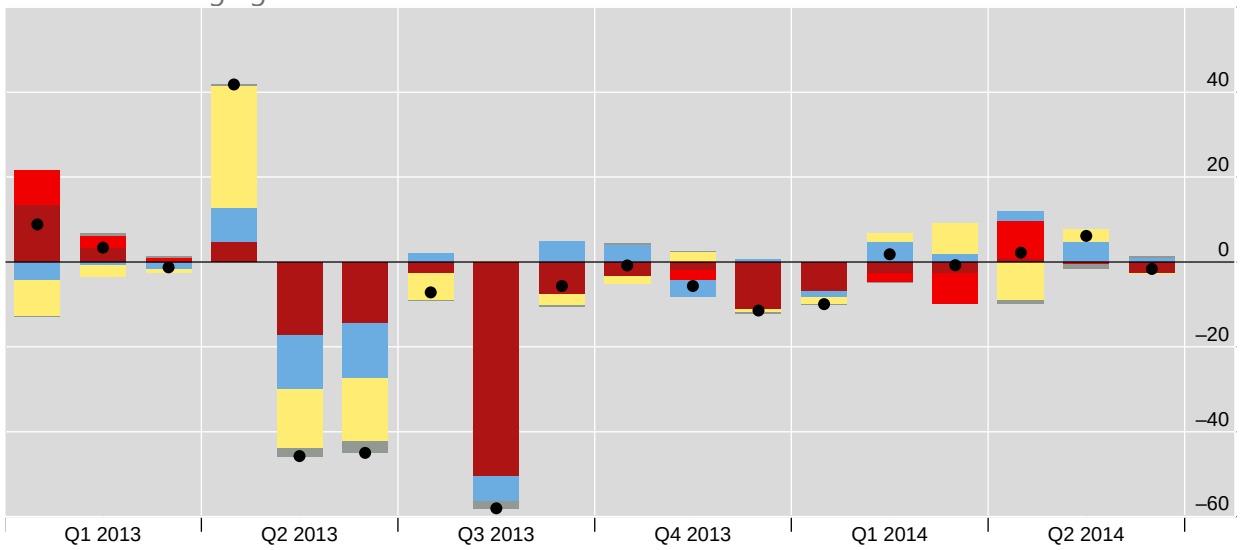


Sources: EPFR; authors' calculations.

Breakdown of monthly changes in the net asset value of individual funds

Global EME international bond funds, in millions of US dollars — Appendix Graph 2.2

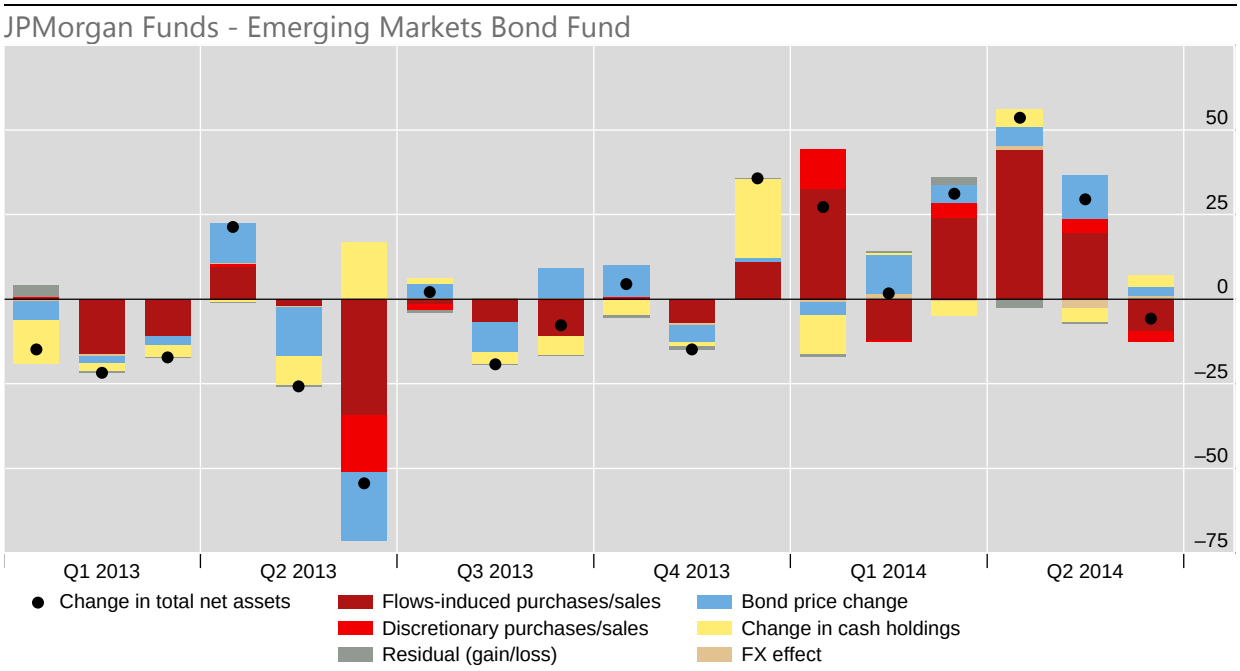


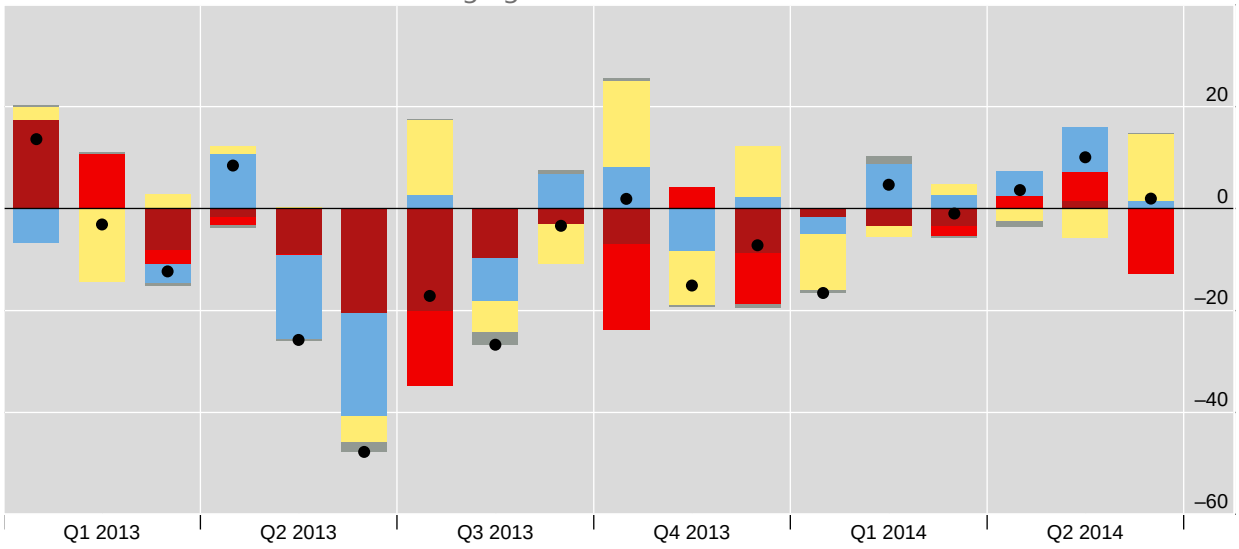


Sources: EPFR; authors' calculations

Breakdown of monthly changes in the net asset value of individual funds (Continued)

Global EME international bond funds, in millions of US dollars — Appendix Graph 2.2





Sources: EPFR; authors' calculations.

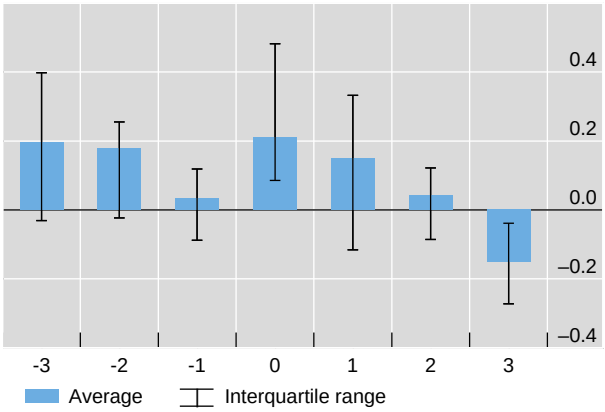
Appendix 3: Cross-correlograms for investor inflows vs outflows and for investor-driven purchases vs sales

Breakdown by direction of investor flows

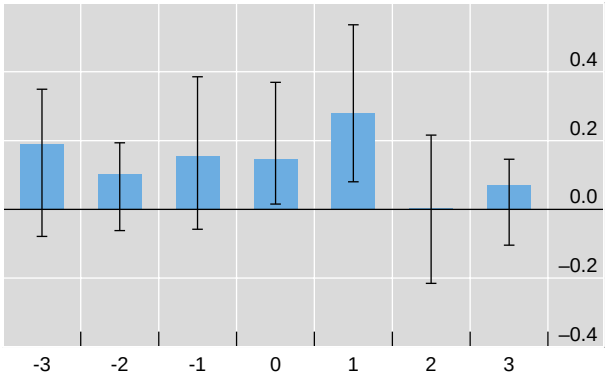
Appendix Graph 3.1

Cross-correlogram between investor inflows only and discretionary purchases

International bond funds (18)

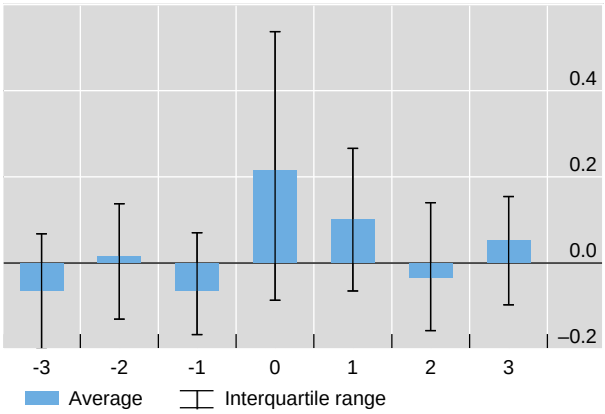


Local currency bond funds (17)

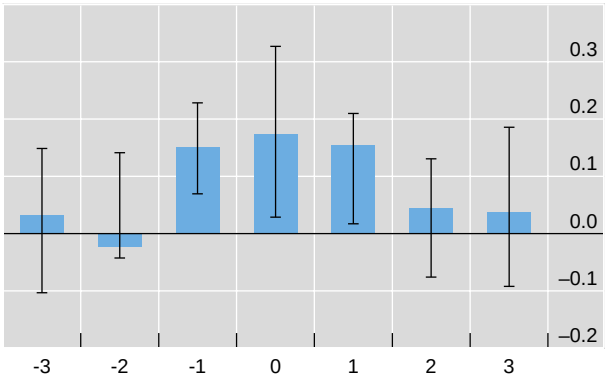


Cross-correlogram between investor outflows only and discretionary purchases

International bond funds (18)



Local currency bond funds (17)



Figures in brackets represent the number of funds used in the calculation in each category. The bars for 0 on the horizontal axis shows the contemporaneous correlation, those for +1 the correlation between investor inflows only (or outflows only) in month t and discretionary purchases in month t+1, and those for −1 the correlation between investor inflows only (or outflows only) in month t and discretionary purchases in month t−1.

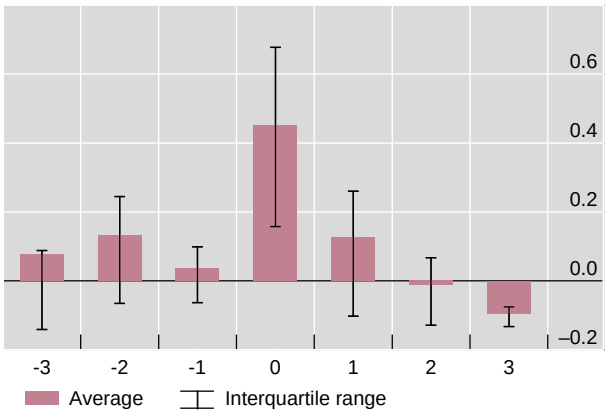
Sources: EPFR; authors' calculations.

Breakdown into flow-driven purchases and sales

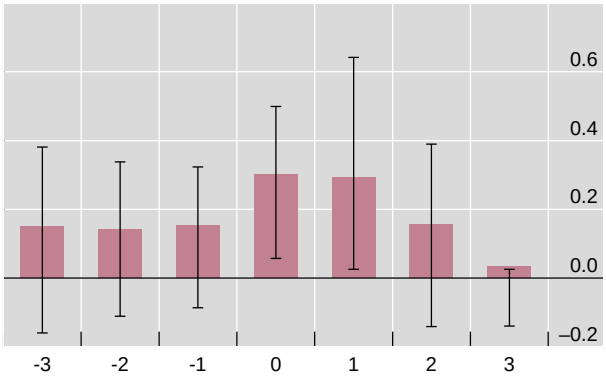
Appendix Graph 3.2

Cross-correlogram between flow-driven purchases only and discretionary purchases

International bond funds (18)

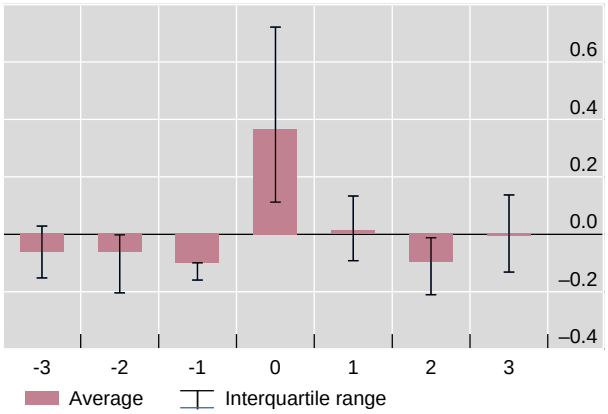


Local currency bond funds (17)

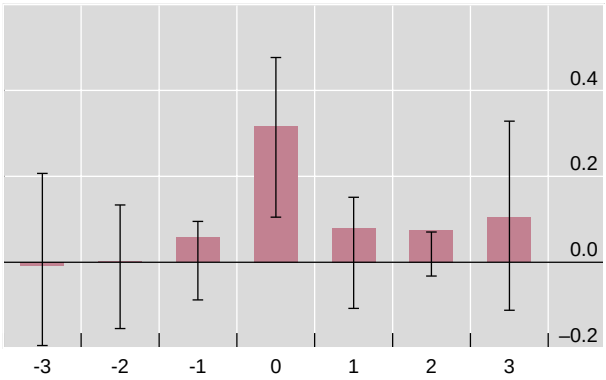


Cross-correlogram between flow-driven sales only and discretionary purchases

International bond funds (18)



Local currency bond funds (17)



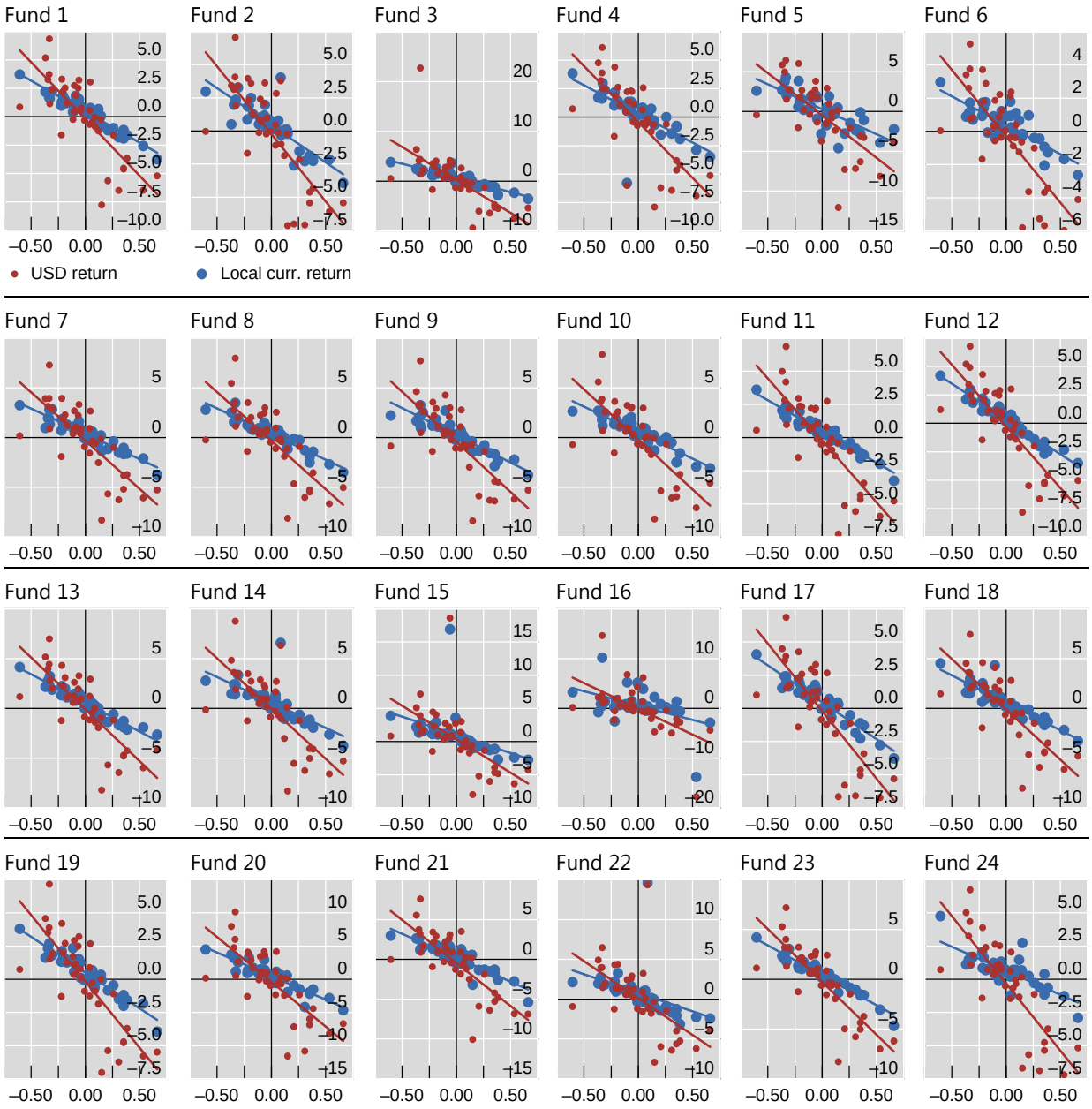
Figures in brackets represent the number of funds used in the calculation in each category. The bars for 0 on the horizontal axis shows the contemporaneous correlation, those for +1 the correlation between investor-driven purchases only (or sales only) in month t and discretionary purchases in month t+1, and those for −1 the correlation between investor-driven purchases only (or sales only) in month t and discretionary purchases in month t−1.

Sources: EPFR; authors' calculations.

Appendix 4: Scatter plots from duration analysis

Scatter plots of changes in the value of EME local currency bond fund to yield changes

Appendix Graph 4.1

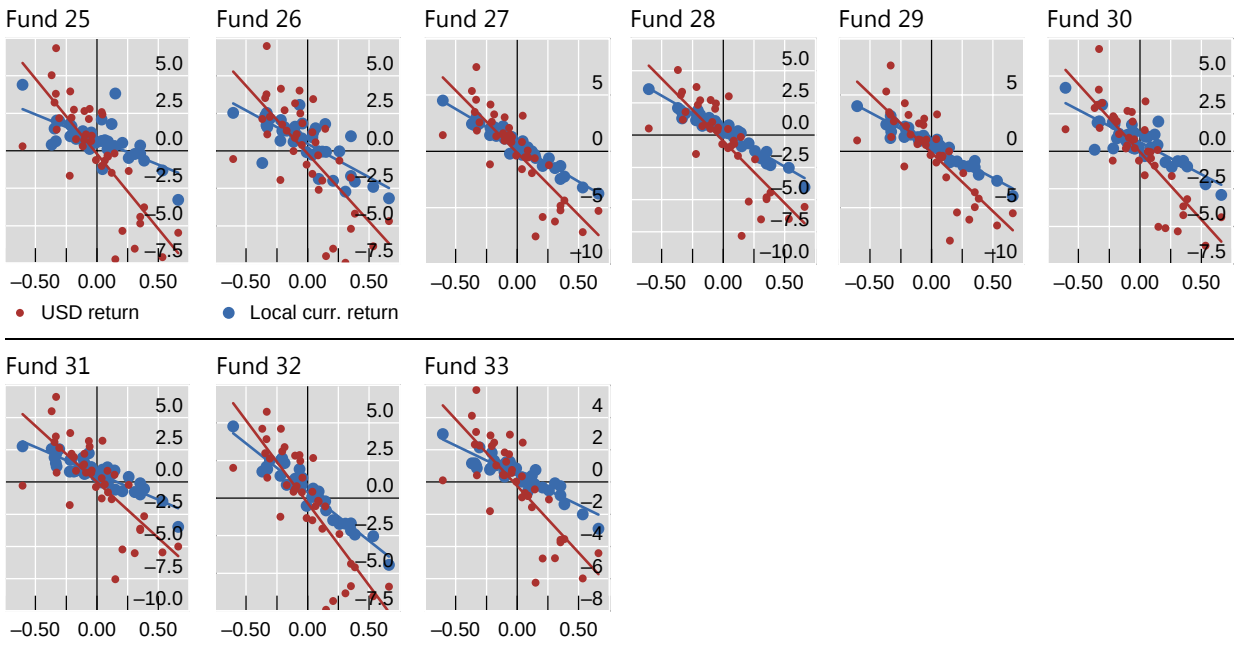


Red dots represent the US dollar value of the change in each fund's mark-to-market value, while blue dots show the local currency value. The slope of the red line represents US dollar duration, while the slope of the blue line shows the local currency duration of each fund.

Sources: EPFR; authors' calculations.

Scatter plots of changes in the value of EME local currency bond fund to yield changes (continued)

Appendix Graph 4.1

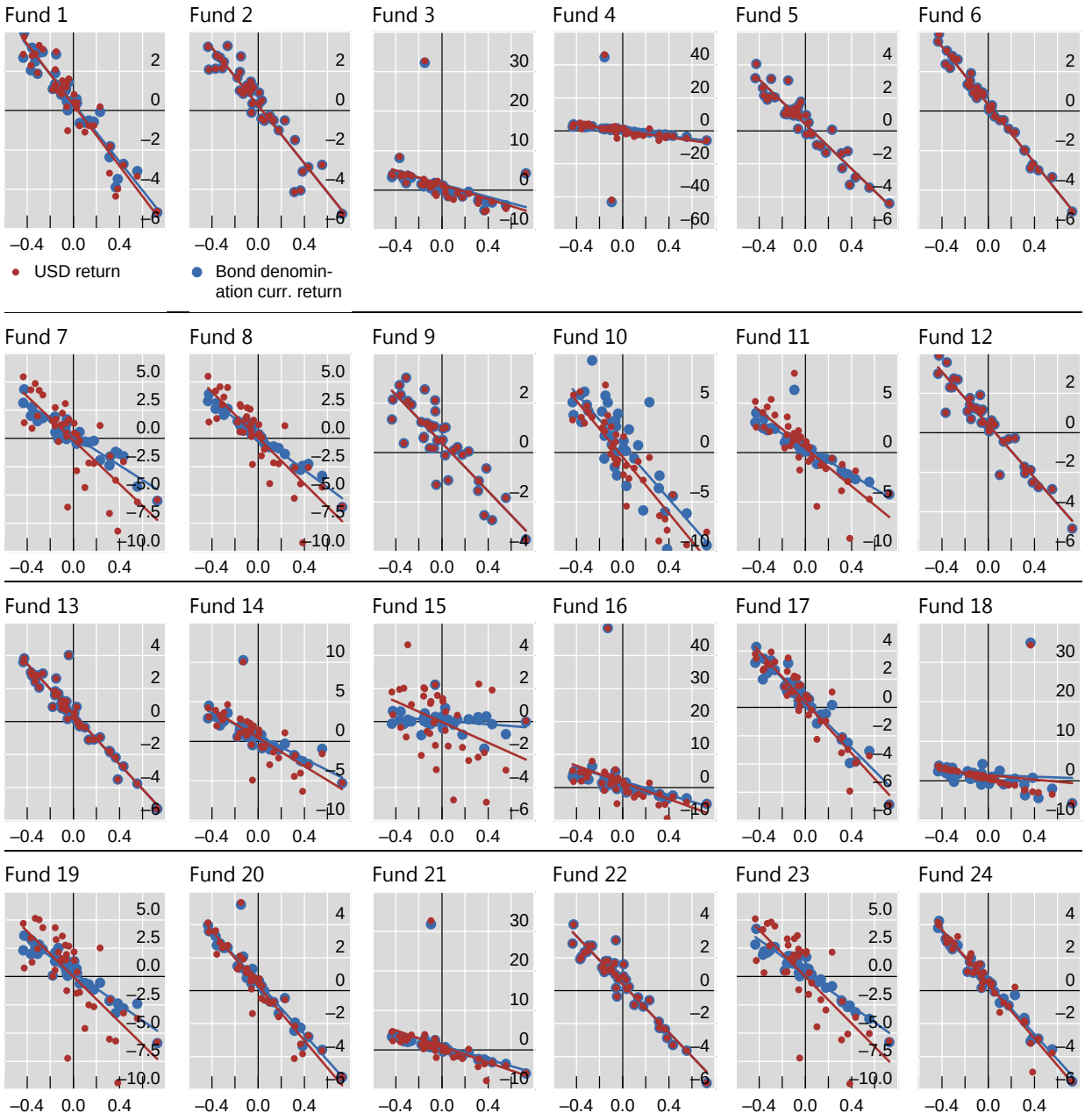


Red dots represent the US dollar value of the change in each fund's mark-to-market value, while blue dots show the local currency value. The slope of the red line represents US dollar duration, while the slope of the blue line shows the local currency duration of each fund.

Sources: EPFR; authors' calculations.

Scatter plots of changes in the value of EME international bond fund to yield changes

Appendix Graph 4.2

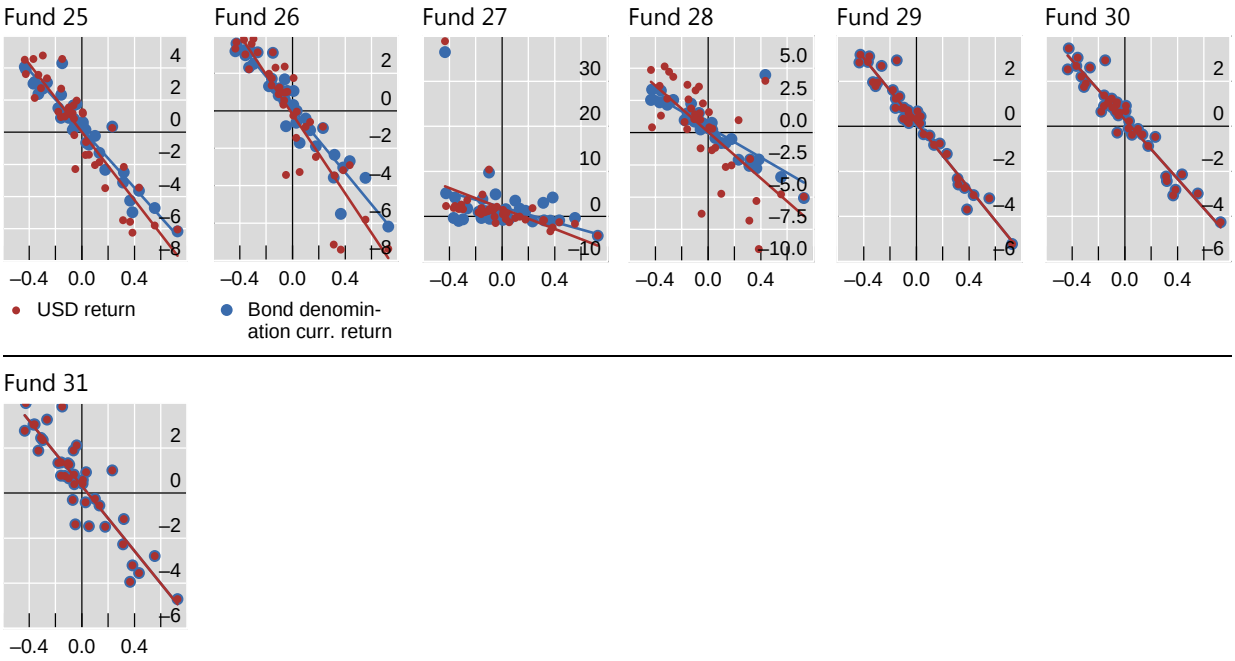


Red dots represent the US dollar value of the change in each fund's mark-to-market value, while blue dots show the value in the currency of bond denomination of change. The slope of the red line represents US dollar duration, while the slope of the blue line shows the duration of each fund in the currency of bond denomination.

Sources: EPFR; authors' calculations.

Scatter plots of changes in the value of EME international bond fund to yield changes (continued)

Appendix Graph 4.2



Red dots represent the US dollar value of the change in each fund's mark-to-market value, while blue dots show the value in the currency of bond denomination of change. The slope of the red line represents US dollar duration, while the slope of the blue line shows the duration of each fund in the currency of bond denomination.

Sources: EPFR; authors' calculations.

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