Capital flows: the role of fund manager portfolio reallocation*

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Abstract

This paper analyzes drivers of capital flows channeled by mutual funds, disentangling capital flows resulting from investor behavior and those resulting from fund manager reallocation in order to analyze the distinct factors relevant to each. We construct a novel dataset of global bond funds for the period 2011 to 2017 and investing in 18 emerging market economies, exploiting quarterly data from Morningstar on individual securities in mutual funds' portfolios to calculate distinct measures of investor flows and manager reallocation. Our regression results show differentiated effects of push and pull factors on investor flows versus manager reallocation. We find that managers partially counterweight investors responses to external variables, and with respect to reallocation, when adding covariates to capture liquidity, leverage, and benchmark effects, we find strong evidence of the importance of these institutional factors, including a "safe-haven" effect, whereby managers allocate towards "safe" EMEs during periods of high global risk aversion.

Keywords: mutual funds, capital flows, financial stability, emerging markets, portfolio allocation, asset management, non-bank financial intermediaries

JEL codes: F32 G11 G15 G23

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1 Introduction

Foreign capital inflows can support economic growth, but sudden surges or reversals can threaten economic and financial stability. Capital inflows can facilitate the adoption of more advanced technologies and reduce the cost of capital by enabling better global allocation of risk (Rogoff et al., 2004). However, surges in capital inflows can appreciate exchange rates and fuel excessive credit growth and current-account deficits (Elekdag et al., 2009, Erten et al., 2021). And, sudden reversals of capital inflows can lead to exchange rate pressures, slower economic growth, and financial crises (Calvo and Reinhart, 2000). Certain types of foreign capital flows are particularly volatile. (Pagliari and Hannan, 2017), among others, provide evidence that portfolio flows, purchases and sales of financial securities, are the most volatile. These flows are increasingly channeled via investment funds, particularly as bank-intermediated portfolio flows retrenched in the aftermath of the Global Financial Crisis (Shin (2013), Takats (2010)). As of end-2018, investment funds' share of total cross-border portfolio flows was 60% ((Kaufmann, 2020)).[1]

Investment funds are structures such that investors can buy shares in a fund and professional fund managers buy and sell assets according to the investment mandate for that fund. Investment funds can be categorized as private funds (hedge funds, private equity) or mutual funds. The vast majority of mutual funds are open-ended.[2] So-called open-ended funds (OEFs) allow investors to redeem from the fund at any time, embedding the potential for a "run" on this type of fund.[3] Portfolio managers allocate the capital available for investment across asset classes and execute positions in particular securities, following the fund mandate. For actively managed funds, managers reallocate as they change their view of a particular security, and as they manage investor redemptions. Capital flows channeled via mutual funds are thus purchases and sales of a country's assets driven either by fund investors or portfolio manager behavior.

Along with the growth of mutual funds, the participation of emerging market economies (EMEs) in global financial markets has increased markedly in recent decades. External assets and liabilities have been growing since the 1990s and were equivalent to around 130% of GDP at the end of 2018 (Figure 1). Portfolio debt is a crucial asset

[1] More generally, the financial assets of Non-Banking Financial Intermediaries, including insurance corporations, pension funds, Other Financial Intermediaries and financial auxiliaries, accounted for almost 50% of the global total, amounting to around USD400trn in 2019, up from around USD100trn in 2011, (FSB, 2021).

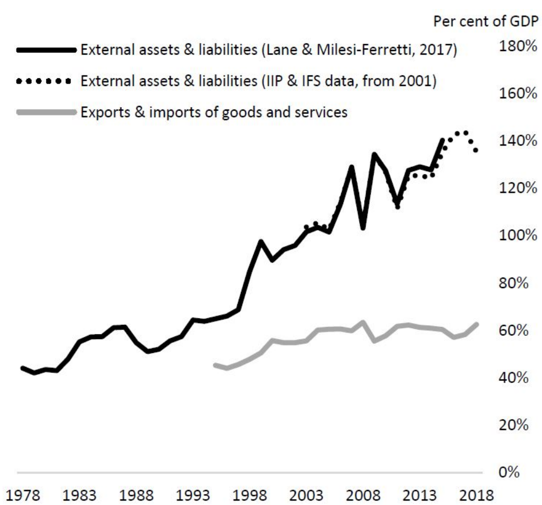
[2] At end-2018, US open-ended funds (OEFs) had around USD21.4trn in assets under management. US closed-end funds had around USD250bn in assets under management (ICI, 2019).

[3] And, (IMF, 2019) argue that mutual funds are susceptible to herding behaviour and liquidity shocks.

class for external funding for EMEs and overtook loans as a proportion of net external financing for EMEs in 2012 (Shin (2013)). Around 20% of EME bonds are now held by foreign investors, compared to 16.5% in 2006 (Figure 2).

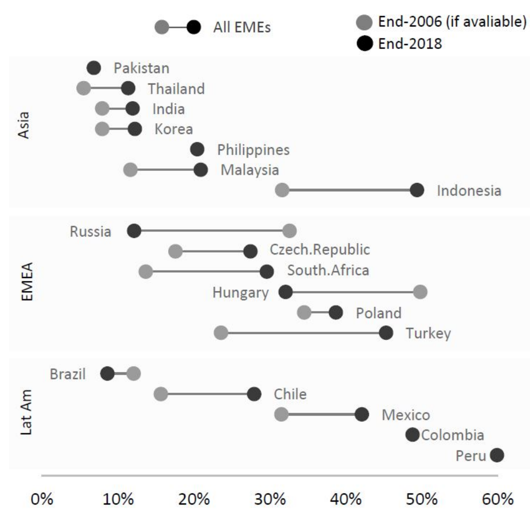
One key channel for foreign participation is via open-ended global bond funds. These have increased in size and exposure to EME sovereign bonds. Mutual fund flows to emerging markets now account for around one third of total portfolio flows, compared to around one tenth pre-crisis (Carney, 2019). The assets of mutual funds investing in EME bonds have increased seven-fold since 2008 (Hui, 2018) and these inflows could lead to vulnerabilities (Ramos-Francia and Garcia-Verdu (2018)). Cortes et al. (2020) shows that in 2018 these funds have almost doubled their assets under management since 2009, with a proportional increase in their exposures to EMEs fixed income, reaching up to 19% of total assets for the average fund. Around 98% of EME bond funds are actively managed (Shek et al., 2018).

Figure 1: Financial and trade openness for select EMEs



Financial openness defined as external assets and liabilities as a proportion of GDP. Trade openness defined as the sum of exports and imports as a proportion of GDP. Sources: IMF, Lane and Milesi-Ferretti (2018), World Bank and authors calculations.

Figure 2: Proportion of bonds held by overseas investors



Calculated as the value portfolio debt liabilities reported in IMF balance of payment statistics (for 2018) and Lane and Milesi-Ferretti (2018) (for 2006) divided by total debt liabilities reported by BIS.

These developments in global financial structure, and the risks associated with OEFs, point to the importance of understanding the behavior of mutual funds in the international context, and in particular with respect to EMEs. This paper addresses the question of what drives capital flows intermediated by mutual funds, disentangling capital flows resulting from investor behavior and those resulting from fund manager allocation in order to analyze the distinct factors relevant to each. This research can contribute to and inform the broader debate about opportunities and challenges arising from investment funds, the fastest growing component of non-bank financial intermediation.((Kaufmann, 2020))

We first present case studies using our investor flows and manager allocation measures of capital flows to highlight the importance of each channel. Using regression analysis, we test the effect of push (global or external) and pull (domestic) factors, highlighted in the capital flows literature, on investor flows and fund manager reallocation. We then extend the econometric model to include fund-level institutional factors, alongside the push/pull variables, in order to test their influence on manager allocation. We include the institutional features of mutual funds discussed in the asset manager literature: liquidity, leverage and benchmark inclusion effects. We also introduce and test for a "safe-haven" effect: during periods of high global risk aversion, managers may allocate towards "safer" EMEs. Finally, we analyze whether our results generalize across funds that vary in the intensity of their exposure to EMEs.

A first-order challenge of implementing our analysis is that we do not directly observe manager reallocation. In order to study this component of capital flows, we need to extract from the existing data distinct measures of investor flows and manager reallocation. To do this we construct a novel dataset exploiting quarterly data from Morningstar on individual securities in mutual funds' portfolios for 2011 to 2017. The data comprises fund's portfolio holdings at the security level, and the end-quarter value of the fund's holdings. Changes in the value of a fund's holding of a particular asset in a given period can be attributed to changes in the market price of the asset (fund managers mark their assets to market), appreciation/depreciation of the currency in which the asset is denominated relative to the base currency of the fund; and, to 1) changes in the amount of capital the fund is able to invest and 2) changes in how that capital is allocated.

These latter two components are the focus of our analysis. The first component we define as "investor flows." The amount of capital investors withdraw from or contribute to the fund waxes and wanes, and thus the fund needs to buy and sell assets. The second component, we define as "manager reallocation." Managers of active funds choose how much to invest in different assets, subject to any constraints in their mandate. To implement a change in their investment preferences, the manager buys and sells assets. We define "reallocation" as any change in a fund's holding of an asset which cannot be attributed to changes in the price of the asset, exchange rate effects, or changes in the level of capital available to the fund. Note that investor flows occur at the fund level, whereas manager reallocation occurs at the security level.[4]

[4]This measure of manager allocation is not equivalent to the fund manager discretionary sales measure used in Morris et al. (2017), Shek et al. (2018) which is defined using the fund's cash holdings. We are interested in managers discretionary allocation decisions.

1.1 Related Literature

To focus on the financial intermediary channel and the role of the fund manager, our paper builds on two strands of literature: research on the drivers of global capital flows and research on fund manager behavior.

From the literature on drivers of capital flows, there is evidence that different types of flows are sensitive to different factors, categorized as either pull (domestic) or push (global or external). Koepke (2019) provides a survey of empirical literature on Emerging Market capital flows and illustrates that global risk aversion negatively affects portfolio and banking flows, while pull factors (domestic output growth, asset returns and country risk) seem relevant for banking flows. Cerutti et al. (2019) illustrate that the relative importance of push factors varies greatly by type of flow.[5] Forbes and Warnock (2012) focus on particular surges and "sudden stop" episodes for foreign flows finding these extreme events are associated with global factors.

Another set of papers analyses the role of particular capital flow channels. Most focus on banks, partly given their historic importance: before the Great Financial Crisis (GFC), bank loans accounted for around 30% of non-FDI capital inflows to EMEs (Cerutti and Hong (2018)). And, partly due to data availability: the Bank for International Settlements (BIS) publish data on cross-border bank lending.[6] The results focus on the financial intermediation function of banks and heterogeneity across banks with respect to their business models and balance sheets.

The literature which analyses capital flows channeled via mutual funds has mostly focused (implicitly or explicitly) on decisions made by the investors in the funds. Fratzscher (2012) finds that push (global or external) factors were the main drivers of fund capital flows during the GFC, while pull (domestic) factors where more dominant in 2009/2010. Miyajima and Shim (2014b) note that investor flows to funds reinforce EME asset price changes. Cerutti et al. (2019), Koepke (2019) and Kaufmann (2020) show funds distribute shocks, especially to EMEs, and Puy (2016), Raddatz and Schmukler (2012) discuss how investment fund flows foster procyclicality. Brandao-Marque et al. (2015) explicitly focus on investor types and argue that the change in the mix of global investors has made flows to EMEs more sensitive to external factors. Converse et al. (2020) highlight the growing importance of exchange traded funds (ETFs), especially for equity markets, and show evidence that for capital flows to EME dedi-

[5] Highlighting domestic policy and institutions, Bush (2019) finds that portfolio debt flows are not sensitive to capital account liberalization while FDI and inward equity flows are.

[6] Takats (2010), for example, uses this data to conclude that cross-border bank lending to EMEs dropped during the GFC, principally due to a fall in the supply of overseas credit (rather than a lack of demand).

cated funds, flows to ETFs are more sensitive to global factors than standard mutual funds.

The literature taking into account fund manager behavior finds evidence that the allocation decisions made by the fund managers themselves are a key factor, a theme that the broader asset management literature highlights. For example, to manage liquidity, Manconi et al. (2012) find that in the GFC, funds which held both securitised bonds and corporate bonds tended to retain the former - which had become illiquid - and sell the latter. Morris et al. (2017) analyze liquidity management in open-ended funds. These authors model and test for a"pecking order" theory of liquidity management whereby fund managers use their cash holdings to meet redemptions by the fund's ultimate investors, thereby providing a stabilizing effect on asset price changes driven by investor redemptions. However they show in their model, and in the data, the reverse. Managers hoard cash when faced with investor redemptions, selling assets to do so. Fischer et al. (2021) and Timmer (2018) find that funds' portfolio rebalancing during periods of stress accentuate excessive volatility in capital markets, and might even mutually reinforce investors' redemptions (Shek et al. (2018)).

With respect to benchmarks, Raddatz et al. (2017) and Arslanalp and Tsuda (2015) analyse the impact of changes to indices which mutual funds benchmark against and find that when a country's share of an index increases, it tends to receive positive capital inflows. And, as Forbes et al. (2016) show with the implementation of capital controls in Brazil, managers react to policy signals. Most similar to our paper, Kaminsky et al. (2004) specifically disentangle and analyze investor and fund manager behavior to understand whether these actors reinforce or counterweight each other's decisions. The authors analyze mutual funds invested in Latin American equity markets and find that both managers and investors practice momentum trading strategies and contagion trading, selling (buying) assets from one country when asset prices fall (rise) in another.

This paper's contribution is to estimate two components of mutual fund capital flows to EMEs, (i) investor flows and (ii) manager reallocation, in order to assess the drivers of each component and to analyse the role of institutional features of the mutual fund channel. We make a methodological contribution by defining and quantifying flows attributed to investors versus managers, exploiting security-level data on bond mutual fund portfolios. We then use regression analysis to test for the influence of external and domestic macroeconomic factors, and a set of fund-level institutional factors (redemption/liquidity management, leverage management and benchmark changes). We also introduce and test for a new mechanism we term the "safe-haven" effect. Previous papers have focused on only a single institutional driver of manager allocation, and have relied on country index level data to calculate portfolio capital flows which generates mis-measurement, as well as conflating investor and manager decisions.

Our results show first, that both investor flows and manager reallocation are important for portfolio flow dynamics and are not always in the same direction. Second, we find differentiated effects of push and pull factors on investor flows versus manager reallocation, push factors are more relevant for investors, pull factors for fund managers. Third, we find strong evidence of the importance of institutional factors, including the "safe-haven" effect, as drivers of manager allocation decisions.

The remainder of the paper is structured as follows. Section 2 sets out our regression model approach including construction of our right hand side variables. Section 2.1 describes our model to test the role of push and pull factors in driving investor flows and manager reallocation, and section 2.2 extends the model to include institutional features as potential factors explaining fund manager reallocation. Section 3 explains how we distinguish between investor flows and manager reallocation, defining our dependent variables. In doing so we introduce our security-level dataset and fund sample. Section 5 reports our results and analysis of these results. Section 6 outlines robustness checks. Section 7 discusses broad implications of the results and concludes.

2 Explaining investor flows and manager reallocation

We use regression analysis to test our hypotheses about investor behavior and manager decisions, estimating our econometric models using a sample of quarterly data for 2011 to 2017 on mutual fund portfolios, including fund holdings of bonds from 18 EMEs. We first test for the effect of variables identified in the capital flows literature (push and pull factors), and next we test for the role of institutional features of mutual funds discussed in the asset manager literature. We also construct and test for a new factor which we term the "safe-haven" effect: during periods of high global risk aversion, managers will allocate towards "safe-haven" EMEs, for example in order to boost liquidity while not sacrificing yield. Data for calculating fund investor flows and manager reallocation variables, as well as fund institutional features, are sourced from Morningstar. Details and sources for pull (domestic) variables and push (external) factors are listed in Annex B.

2.1 Push and pull factors

We estimate the following model of capital flows for country i in period t via fund j:

$$CapitalFlowMeasure_{j,i,t} = \alpha_0 + \beta' Push_t + \gamma' Pull_{i,t} + \chi' X_j + \eta_{j,i} + \epsilon_{j,i,t} \qquad (1)$$

where $Push_t$ is a vector of push (external) factors, $Pull_{i,t}$ is a vector of pull (domestic) factors, $\eta_{j,i}$ are fixed effects for each fund-country combination, and X_j are fund level controls, the age and the size of each fund. Standard errors are calculated so as to be robust to heteroskedasticity, auto-correlation and cross-sectional dependence.

Our two dependent variables are investor flows and manager reallocation.[7] Investor flows for fund j are measured as the change in the total portfolio value that is not due to valuation effects (changes in the market price of a security and, if applicable, currency appreciation or depreciation).[8] Manager reallocation is measured at the asset level, and is the change in asset value that cannot be attributed to valuation effects or changes in the level of capital available to the fund.[9]

We scale our capital flow measures in two ways. First, we scale by the fund's total holdings of EME bonds at the start of the quarter. This assumes fund managers think about risk on an asset-class basis, and treat EME bonds as an asset class. Second, we scale by the funds' total net assets at the start of the quarter. This assumes managers assess risk at the portfolio level. For example, if a \$1bn fund with \$100mn in EME bonds increases its exposure to Mexico from \$20mn to \$50mn, this would be a 30% increase in exposure to Mexico on an asset-class basis, and a 3% increase at the fund level.

Both the portfolio and asset-class perspective are relevant. Managers are judged on overall portfolio returns, and they may have explicit or implicit limits on EME bond exposure.[10] Scaling by EME bond holdings, identifies the largest reallocation events such as when funds with a small number of EMEs in their portfolio change their holdings. Scaling by total net assets identifies the largest reallocation events such as when funds with large EME bond portfolios change their holdings.[11]

The distributions for manager reallocation, individual fund investor flows and thus

[7] We implement a micro-data based calculation to dis-entangle investor flows from manager reallocation, described in more detail in Section 3 and in Annex F in the Appendix.

[8] The valuation effect for security k is defined as $VC_{k,t}$ in equation (3) and investor flows is defined for fund j as $IF_{j,t}$ in equation (4) in Annex F in the Appendix. Intuitively, if the portfolio value is larger in the current period after accounting for valuation effects, this is due to investor inflows, if it is smaller, this is due to investor redemptions or outflows.

[9] Manager allocation is defined as $MA_{j,k,t}$ in equation (5) in Annex F in the Appendix. Intuitively, if the manager reallocates capital the value of the asset will be different from the value if she had reduced or increased her position proportionally across all the assets in the entire portfolio.

[10] An implicit limit might include, for example, a limit on non-investment grade bonds.

[11] Results are similar for both measures.

our capital flow measures, are leptokurtic – thin shoulders and fat tails. Implementing ordinary least squared regressions on the un-transformed variables will result in non-normally distributed residuals, which would lead to inaccurate inferential results regarding p-values and confidence intervals (Pek et al., 2018). To address this we transform the dependent variables by centering relative to their median and taking a cube root transformation.[12] This method is preferred to trimming the sample at the tails given those observations could coincide with large funds where managers invest/divest rapidly, e.g. as in the case of Hungary.[13]

Push factors refer to external conditions such as advanced economy interest rates that affect overseas demand for EME assets. Pull factors refer to domestic conditions such as GDP growth that help attract foreign capital. Following Koepke (2019)'s survey of the capital flows literature, we include three pull factors and three push factors.

In estimating a model with push and pull factors using a vector of variables, our approach is similar to, for example, Forbes and Warnock (2012) and Rey (2013). Other papers have sought to capture global common factors by including time fixed effects in their regressions in lieu of external variables such as advanced economy interest rates and systemic risk (e.g.Cerutti et al. (2019), Goldberg and Krogstrup (2018)). Time fixed effects capture all factors that affect capital flow pressures in a given period in the same way across countries, and this approach is useful for assessing the extent to which EME capital flows are accounted for by a global financial cycle. However, our objective is to compare investor and manager responsiveness to each push and pull factor, rather than distinguish between the relative importance of total push and total pull factors. Hence, we use a vector of global push factors.

The first push factor we include in our analysis is global risk aversion. When global risk aversion increases, capital flows to EMEs tend to fall. Koepke (2019) finds that the two most common proxies for global risk aversion used in the literature are US implied equity volatility (the VIX) and the US BBB-rated corporate bond spread over US Treasuries. Neither of these are ideal proxies for our analysis of bond flows. The former does not necessarily imply bond market volatility, it is based on US equity market options. The latter is driven by factors such as duration and liquidity, not only risk aversion. Furthermore, they are single measures. We use a composite measure constructed by the Kansas City Fed to capture overall financial stress, which includes the VIX as well as a range of other important variables.[14] This measure is meant to

[12]See Annex G for more detail.

[13]Other researchers using fund-level data, such as Converse et al. (2020), Kaufmann (2020), choose various data cleaning techniques which may obviate the need for transforming their dependent variables.

[14]For more detail on the construction and behavior of this financial stress index, please see Hakkio and Keeton (2009) and https://www.kansascityfed.org/data-and-trends/

capture various factors such as flight to quality and liquidity, as well as uncertainty about asset values, all of which contribute to global risk aversion.

Our second push factor is external interest rates. When external interest rates increase, capital flows to EMEs tend to fall. Koepke (2019) notes this is typically proxied using US rates. We also use US rates, rather than developed market rates more generally, because US bonds alone account for over 60% of our sample of funds' non-EME bond portfolios. The average remaining maturity of our funds bond portfolios is 7.7 years, and as such we use 10 year bond yields.[15]

Our third push factor is advanced economy output growth, There are conflicting findings in the capital flows literature regarding its impact on capital flows to EMEs. Cerutti et al. (2019) note that a slowdown in advanced economy growth leads to an expansion of capital flows to EMEs as investors take advantage of better growth and higher yields. These findings are echoed elsewhere (Reinhart and Reinhart, 2009). However, other analyses have identified a positive relationship between external growth and gross capital inflows to EME (eg. Forbes and Warnock (2012)). This is possibly because faster advanced economy growth results in greater investor risk appetite. Also, investors and managers may have different sensitivities to developed market growth. We proxy external output growth in our analysis using US growth.

Our fourth push factor is trade policy uncertainty, proxied by the text-search based index of US trade policy uncertainty from Baker et al. (2016).[16] In the capital flows literature, this variable is not traditionally included as a push factor. However in the recent period, trade fragmentation and policy uncertainty have risen, driven by the Brexit referendum vote and the US-China trade war. De-globalization may ensue in financial markets as well, and at a minimum, financial flows are likely to have been affected by uncertainty surrounding trade relations.

Our first pull factor is domestic output growth. As domestic growth increases, capital flows to that EME tend to increase. Here we use each EME's real GDP growth relative to the EME (GDP weighted) average. We use this relative measure since when choosing to invest more or less in a particular EME, the decision is likely driven by its economic growth relative to other EMEs.

Our second pull factor is domestic asset returns. As asset returns increase, capital

kansas-city-financial-stress-index/. Our results are robust to using the VIX and the US BBB-rated corporate bond spread over US Treasuries instead of the Kansas City Fed measure.

[15] "On the run" bonds - such as the 10 year - are typically more liquid and thus data is more easily available.

[16] Available from https://www.policyuncertainty.com/categorical_epu.html. Trade policy words include import tariffs, import duty, import barrier, government subsidies, government subsidy, WTO, World Trade Organization, trade treaty, trade agreement, trade policy, trade act, Doha round, Uruguay round, GATT, and dumping.

flows to that EME increase. Koepke (2019) notes that the strongest evidence is for local stock market returns, however because we are focusing specifically on portfolio debt flows, we use bond yields. For each country we use current real 10-year bond yields relative to the EME (GDP weighted) average.

Our third pull factor is country risk. As country risk increases, capital flows to that EME decrease. Koepke (2019) points towards increased debt to GDP and lower credit rating as indicators of increased country risk. We include relative measures for both of these in our analysis. We also include reserves to GDP, whose importance for determining both outflows and inflows is illustrated in Alberola-Ila et al. (2015).

It is worth mentioning that concerns of endogeneity arise when country variables are used as regressors in capital flow regressions. For example, an EME domestic interest rate may be influenced by the country's capital flows, or both may be driven by some other variable. Hence our specification could suffer from simultaneity issues. However several aspects of our approach mitigate these issues. First, taking the investment fund perspective of investors and managers, our country pull factors are not measured as raw country levels but as relative to the average for the set of EMEs.[17] Second, neither of our dependent variables are aggregate country capital flow measures. Our investor flow dependent variable is at the fund level, and manager reallocation is country-fund specific. Also, we include in the model country and fund fixed effects to control for non-time varying traits.

2.2 Institutional factors and manager reallocation

Reallocation decisions are not only a function of a fund manager's analysis of macroeconomic fundamentals (such as push and pull factors). Managers also reallocate between assets based on institutional features of their fund. Institutional features include, for example, the benchmark the fund tracks, as well as the liquidity and leverage of the fund. These features of mutual funds are of particular interest to regulators: the report by the Financial Stability Board (FSB) investigating structural vulnerabilities in asset managers focused on both leverage and possible liquidity mismatches (FSB, 2017), and their research agenda on the risks of Non-Bank Financial Institutions (NBFI) continues to study these issues ((FSB, 2021)).

In this section we analyze the role of four institutional features in driving manager reallocation decisions. To do so, we augment equation (1) to include a vector of institutional factors ($Institutional_{j,i,t}$). We use the same pull and push factors, and scale the reallocation capital flows in the same two ways.

[17] For more details about our independent variables, please see Annex B in the Appendix.

$$CapitalFlowMeasure_{j,i,t} = \alpha_0 + \beta' Push_t + \gamma' Pull_{i,t} + \kappa' Institutional_{j,t} + \chi' X_j + \eta_{j,i} + \epsilon_{j,i,t} \quad (2)$$

The first institutional factor we proxy in the model is liquidity. As highlighted in Emter et al. (2021) among others, funds are open-ended and need strategies to meet redemptions from investors at short-notice. In anticipation of such redemptions, funds may increase the liquidity of their portfolios in times of stress, manifesting as reallocation away from EME bonds. This would be consistent with the findings of Morris et al. (2017) who show that managers increase their cash holdings when faced with investor redemptions. To test if funds sell EME bonds when redemptions increase, we include an "outflows" variable in the model. This takes the value of 0 when the fund experiences inflows. When the fund experiences outflows, it is the level of those flows scaled by the NAV of the fund.[18]

The second institutional feature is leverage. As discussed in Aramonte et al. (2022) and Bank of England (2018) among others, fund leverage can trigger a need to sell assets. Broadly, funds can generate leverage through either derivatives or secured financing, and we include two proxies to test for the impact of leverage. The first proxy is the mark-to-market value of derivatives reported by the fund. Derivative positions can give rise to short-notice cash requirements: if the mark-to-market value of a derivative asset falls, funds will be required to post cash-equivalents to counterparties. In order to meet such increases in variation margin, funds may need to sell EME bonds. The second proxy for leverage is changes in the ratio of gross to net non-derivative asset values between quarters. A fall in the value of cash leverage might mean that EME bonds can no longer be financed through secured funding markets, leading to a sale of those bonds.

The third institutional feature is changes in the indices which funds benchmark against. Arslanalp and Tsuda (2015), Arslanalp et al. (2020) and Raddatz et al. (2017) find that movements in the underlying country constituents of benchmarks have important effects on bond fund portfolios, and can explain movements in capital flows. A large part of this is due to price and exchange rate effects that we have already captured as valuation changes and removed from our capital flow measures. Bond indices are size weighted and so, all else equal, a relatively large fall in the price a country's bond will result in its share of the index falling. However, the authors also find that exogenous events matter, for example when countries are added or removed from an index. We include two variables to capture this type of benchmark effect.

[18] Results are robust to using one quarter lagged values as instruments for contemporaneous levels.

The first benchmark variable captures changes to the two most popular indices in our sample: JPM's GBI-EM, for the EME bond asset class, and the FTSE's WGBI, a global bond index.[19] Arslanalp and Tsuda (2015) analyze changes in the GBI-EM index and their effect on net foreign purchases of EME bonds, and identify three events when countries' shares of the index significantly changed due to non-valuation effects. Of those three, two involve countries in our sample of EMEs: Colombia and Peru. We include dummy variables for the period when these changes occurred. As for the country shares of the WGBI, a global bond index, in September 2019, our sample of EMEs accounted for 1.89% of the index, with no individual EME accounting for more than 0.62%. We include a dummy variable when countries are added or removed from this index. The only such event in our sample period is South Africa's addition in October 2012 (it entered with a share of 0.45%).

The second benchmark effect variable captures changes to Bloomberg Barclays Aggregate index, a bond index also commonly tracked by our funds.[20] Unlike the prior two indices, this index does not focus only on government bonds, but also corporates and other debt securities. Barclays includes bonds on a bond-by-bond basis provided they have an investment grade rating and are traded in the United States. We proxy bond exit and entry by assuming government bonds are removed from the index when they are downgraded to non-investment grade, and added to the index when they are upgraded to investment grade. Upgrades receive a dummy variable of 1, and downgrades a dummy variable of -1.[21]

We introduce a fourth institutional feature that we define as the "safe-haven" effect and is motivated by the incentives benchmarking induces for managers. During periods of global financial stress, managers need to simultaneously adjust their liquidity (Schrimpf et al. (2021)) while not sacrificing too much yield (Choi and Kronlund (2017), Di Maggio and Kacperczyk (2017)). In particular, managers have incentives to reallocate into more liquid assets, in case abnormal redemption levels materialize, however without actually holding more cash because they must still keep tracking the benchmark, which determines their performance. One way to achieve this is by investing more in what we term "safe-haven" EMEs, and less in other EMEs, when global risk aversion increases, and we test for evidence of this effect.

To define "safe-haven" EMEs, we use five criteria: (i) depth of the bond market, (ii) depth of the hedging market, (iii) accessibility and development of local market

[19] JPM's Government Bond Index-Emerging Markets and FTSE's World Government Bond Index.

[20] This index was known as the Barclays Agg until 2016 when Barclays indeces were bought by Bloomberg.

[21] Downgrades: Hungary in Q4 2011, Russia in Q1 2015, Brazil in Q3 2015, South Africa in Q2 2017. Upgrades: Colombia in Q1 2011, Philippines in Q2 2013, Hungary in Q3 2016, Indonesia in Q2 2017.

infrastructure, (iv) credit rating, and (v) bond price volatility. We identify 11 metrics on which to grade EMEs against these criteria: these metrics, and their values for each EME, are shown in Annex B.1 in the Appendix. To generate a composite score for each EME, we calculate its average rank across each of the five criteria. Korea, Mexico and Poland consistently topped the rankings as "safer" EMEs, these countries' "safe-haven" dummy variable is +1. The remainder receive a dummy of -1.[22] We then multiply these dummies by the difference between the Kansas City Fed Financial Stress Index and its median value. This is intended to capture when financial stress is "relatively high" or "relatively low". When financial stress is high, risk aversion is high, and we expect a "safe-haven" effect.

3 Exploiting security-level data

We do not observe directly manager reallocation, therefore in order to study this component of capital flows channeled by mutual funds, we need to extract from existing data distinct measures of investor flows and manager allocation. To do this we exploit data from Morningstar that provides fund's portfolio holdings at the security level, and the end-quarter value of the fund's holdings. To construct our sample, we first identify the funds in Morningstar Direct that result in our sample in every quarter capturing at least 75% of holdings of sovereign EME bonds.[23] This comprises the top-1,628 largest mutual fund investors in EME bonds.[24]

We then screen this set of funds' portfolios to ensure we only include data which is accurate and relevant. First, because we run our regression analysis on end-quarter data, we remove reports from funds which do not report full security-by-security portfolio data at the end of each quarter.[25] These account for only 8% of funds by total asset

[22]We delineate the top-3 countries for three reasons: (i) these countries represent each of the major EME regions - Latin America, Asia and EMEA - and would be the safest investment option for any fund with a regional mandate; (ii) clustering analysis shows these are the only countries to consistently appear in the top-cluster when the countries are divided into anything between 2 and 6 clusters; (iii) they are the three safest countries in both 2013 and 2018 - other countries' rankings changed.

[23]We include as EMEs those countries classified as emerging markets by at least three of IMF, MSCI, S&P, Russell Group and Dow Jones. To this we add South Korea as it is widely invested in by EME bond funds. We exclude UAE, Egypt and Taiwan as relevant financial and macroeconomic data are not available quarterly from 2011. We also remove Greece for sample coverage issues described in Section 3. The 18 remaining EMEs included in our analysis are shown in Figure 2.

[24]In this paper we are focused on bonds and as such we measure manager reallocation for EME bonds. Bonds are of particular importance both for macroeconomic and financial stability reasons. First, Bonds have been and continue to be a primary source of emerging economy financing via sovereign debt and increasingly corporates. Second, unlike equity which is in perpetuity, bonds mature and require re-investment, creating roll-over risks. Finally, bonds are less liquid than equity and thus liquidity premiums are subject to destabilizing spikes. For these reasons we focus our attention on manager allocation decisions for EME bonds.

[25]For example funds which report intra-quarter, eg. at end-May rather than end-June.

value. Second, we remove duplicated reports. Third, we remove a fund's quarterly report if it is not preceded by a report for the prior quarter or followed by a report for the following quarter. Fourth, we remove reports for funds which are invested in the bonds of only one country. The vast majority of these funds are domiciled in the sole country in which they invest, and we thus assume these are single-country funds, and the fund manager cannot reallocate from one country to another. The ultimate investors in these specialized funds may be allocating across these country funds in a similar manner as the fund managers we analyze. However, we cannot observe this allocation behavior. After these adjustments, our sample size consists of 391 (multi-country) funds, representing 106 different asset managers in different geographical locations, with USD100bn of assets under management (AUM) accounting for 25% of AUM of the original 1,628 funds.[26] The reduction in the sample is primarily due to the exclusion of funds which only invest in the bonds of one country.[27]

We thus obtain the security-by-security data of fund portfolio holdings. With this micro micro-data, we can calculate our two distinct measures of capital flows: i) investor flows, and ii) manager reallocation.

In the prior literature fund flows and manager discretion measures were calculated using price changes of country bond indices to estimate valuation effects (e.g. Arslanalp and Tsuda (2015), Morris et al. (2017), Raddatz et al. (2017), Shek et al. (2018)) or security quantities (Kaminsky et al. (2004)). We exploit granular security-level data, by ISIN, on funds' portfolios to be able to calculate the exact price changes and FX effects experienced by funds. This means we do not mis-measure valuation effects for funds whose portfolios do not match the country bond index (say because they invest in shorter-duration bonds or more hard-currency bonds). With this more precise estimate of valuation effects we can better analyse the residual changes in asset values, and thus portfolio flows.[28]

To illustrate the mis-measurement of valuation effects, Figure 3 shows the distribution of price changes experienced by 100 of our funds for Mexican government bonds during the Taper Tantrum. The dotted line is calculated using the aggregate Mexican bond index (ICE-BAML Mexican Bond Index). The distribution is dispersed with observations in the far left tail, and the hump is to the right of the dotted line. The average price change of Mexican sovereign bonds using our methodology was -6% while

[26]For the pricing analysis – summarised in Annex F – when calculating the median price change over a quarter we include data from the single country funds.

[27]Once we have our sample of funds, the data requires further cleaning, see Annex (F) for details.

[28]Previous papers have used EPFR data, e.g. Puy (2016), Raddatz and Schmukler (2012). Maggiori et al. (2020) and Coppola et al. (2021) also use Morningstar data to analyze the currency composition of mutual funds' investments and the role of tax havens. Morningstar data is available at the security level.

Figure 3: Funds price changes on Mexican government bond assets, 2013Q2

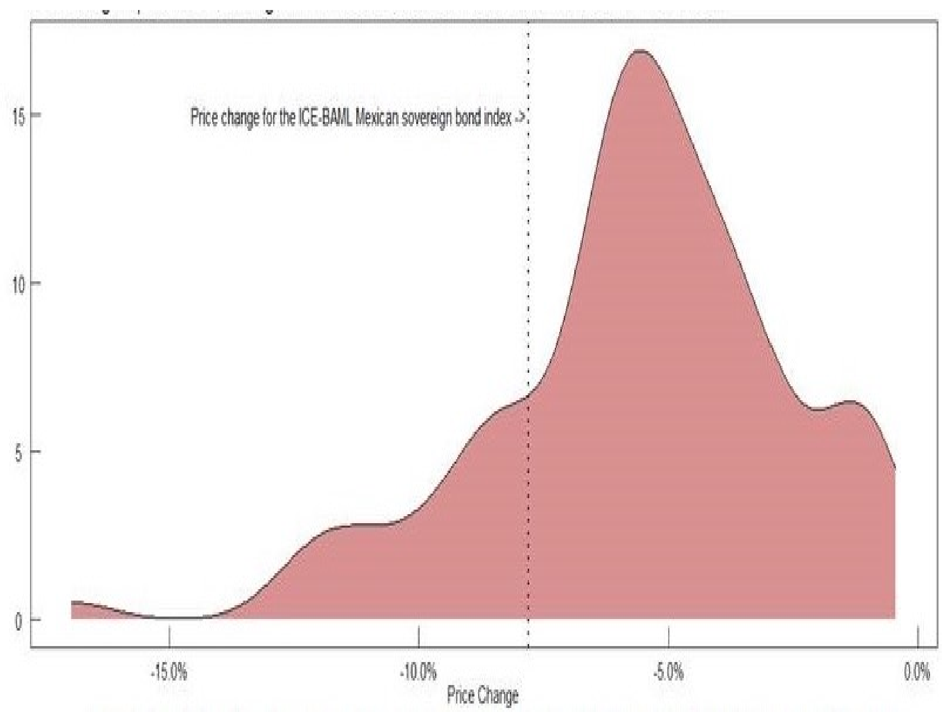
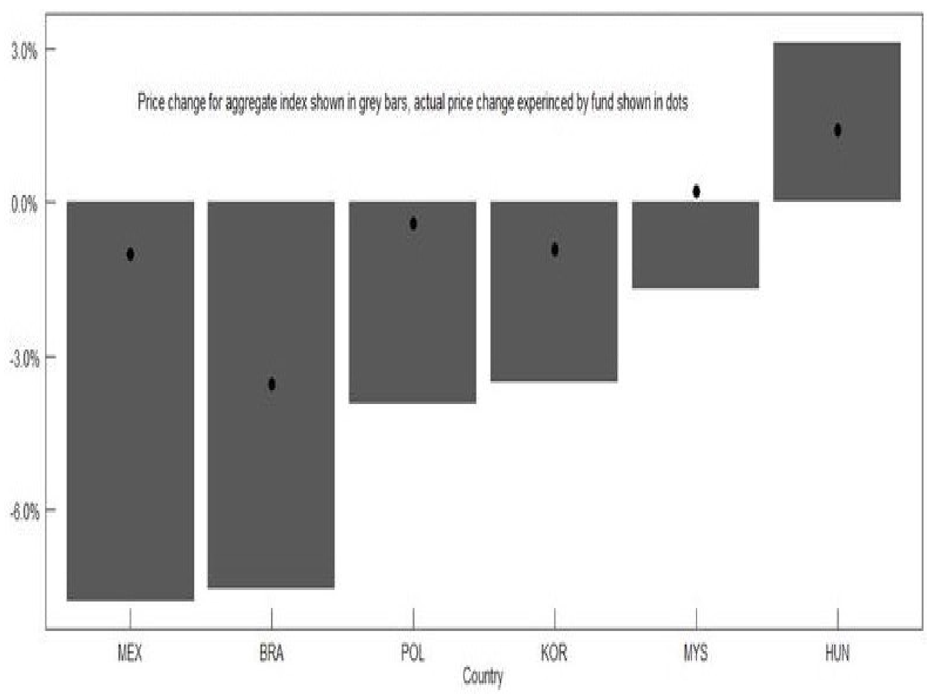


Figure 4: Actual price changes vs. sovereign bond index price changes



the price change using the aggregate index was -8%. A similar disparity occurs with other countries in our sample. Figure 4 shows the largest fund in our sample using data for Mexico, Brazil, Poland, Korea, Malaysia and Hungary. We observe that during the Taper Tantrum the price change of the country aggregate index (the grey bars) exceeds the price change when calculated using our bottom-up methodology (the black dots), and for the Malaysian case, the price change using the aggregate index shows a negative impact while the actual impact was positive.

Our method of exploiting the security-level data is an improvement however, it relies on our ability to identify each security in the portfolio and track its market price and currency denomination in order to calculate valuation changes. When the data is not reported or faulty, we must use less precise techniques. Also, if the security is bought or sold during the quarter and there were dramatic changes within period, we will not capture this. Lastly, because our investor flow measure is a residual, and the manager allocation a further residual, these are subject to some measurement errors. However, these measurement errors do not tilt consistently in one particular direction (See subsection A for more details.)

After computing investor flows and manager reallocation using our bottom-up methodology, we check whether our data over- or under-represent a particular EME.[29] We compare the total value of each EME's assets in the original dataset (Figure 12 in Annex A) to our estimate of their bonds held by non-domestic funds with discretion to divest. The coverage varies across EMEs, but the dataset and our cleaned sample are not dominated by one EME. However we estimate we capture less than 1% of Greek bonds held in relevant funds at end-2017. Given that Greece also has the most extreme independent variables (such as real GDP growth in 2011), we remove it from the sample.

Security-level investor flow and manager reallocation are aggregated by asset class and issuing country for each individual fund, using Morningstar's classification of assets and countries. The bonds comprise government, corporate and local agency debt. Of the EME bonds held by our sample funds, the vast majority are government bonds. Detailed descriptive statistics for our sample, are shown in Figures 8 - 13 Annex A. Our final sample includes data for 271 funds managed by 106 different managers. The data for a typical quarter, includes around 160 funds.[30] The sample size for each quarter is shown in Figure 8 and Figures 9 - 11 show that the broad characteristics of the sample remain similar through time.

The limitations of the data mean that we do not capture all of the capital flows to EMEs channeled via actively managed multi-country mutual funds. Using Morningstar data we estimate that at end-2017 around USD430bn of EME bonds were held in non-

[29] Also, we confirm that changes in the value of "missing assets" are not correlated with changes in the value of another asset class. Had they been correlated, changes which our methodology attributed to "reallocation" to/from a particular asset class could actually be driven by failure to consistently report a particular type of asset.

[30] Funds enter and leave the dataset throughout the sample period.

domestic mutual funds which were not dedicated to bonds from a particular EME. The funds in our sample held USD100bn of EME government bonds in the third quarter of 2017. This represents about a quarter of the bonds held in overseas mutual funds with discretion to divest, which is the sample we want in order to analyze manager reallocation across and out of EME countries. Investments in EME bonds account for 9% of our sample funds' investments. EME bonds are often commingled with other asset classes: less than a fifth of the bonds in our sample are held by funds for whom EME bonds account for more than 60% of their assets. At end-2017, 43% of bonds in our sample were issued by Latin American countries, with countries in Asia and EMEA accounting for 33% and 24% respectively. Thus our sample is broadly in line with each regions' share of total EME government debt outstanding (43%, 37% and 20% respectively). Our sample of USD100bn EME government bonds amounts to only 2% of total EME government bond debt outstanding, and thus we cannot easily extrapolate to quantify aggregate effects from our results. However, we are able to separate and analyze the manager reallocation and investor flow components of EME capital flows using a key financial market segment.

4 Importance of investor flows versus manager reallocation

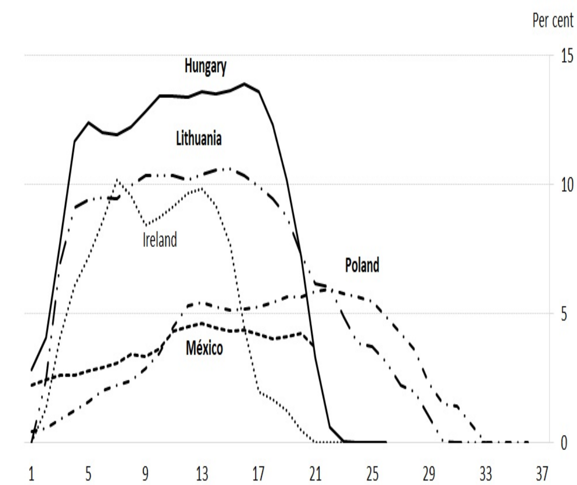
Analysis using our data and statistics from the IMF source shows that the two components of capital flows we delineate are both relevant and not always in the same direction. Manager reallocation is the most significant driver of portfolio debt outflows from individual countries in our sample, consistent with the Hungarian case study outlined below. For each EME, we identify the peak quarterly portfolio debt outflow they experienced between 2011 and 2017 using IMF data, and find that in these quarters, manager reallocation for our funds was equivalent to around 9% of the outflows, while sales due to investor flows were equivalent to around 4% of the outflows.

Investor flows are the most significant driver of portfolio debt outflows from EMEs in aggregate. In quarters between 2011 and 2017, where aggregate fund holdings of EME bonds fell due to non-valuation effects, investor flows accounted for around three-quarters of the fall, while manager reallocation accounted for around one-quarter.

4.1 Case study of Hungary in 2015-16

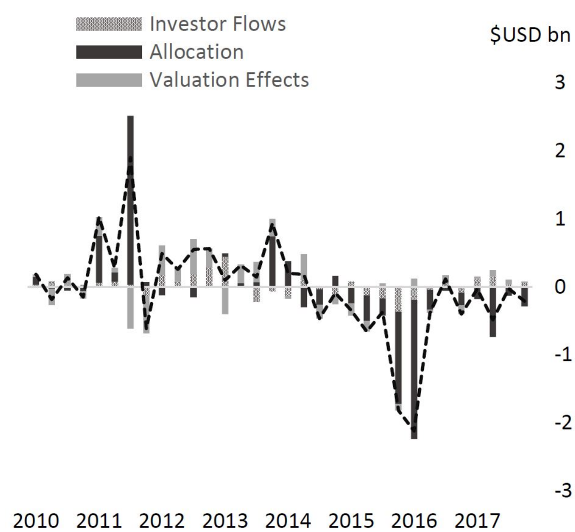
Between 2012 and 2014, holdings of Hungarian bonds grew due to a combination of investor inflows, positive valuation effects and positive reallocation. But this reversed sharply in 2015 when managers reallocated strongly away from Hungary. This coincided with an effort by the Hungarian government to increase "self financing." (MNB, 2015) To achieve this, the government replaced hard-currency debt with local-currency debt and issued more retail focused bonds, while the central bank replaced two-week central bank bills with three-month time deposits. Combined, these changes had the effect of driving domestic banks into short dated Hungarian sovereign debt (MNB, 2016) - which the funds in our sample were large holders of. Indeed one manager alone held 14% of total Hungarian sovereign debt at the start of 2015 – a position which it reduced to 0% within 6 quarters (See Figure 5). Figure 6 breaks down Hungarian flows, for all asset managers in our sample, into investor flows and manager reallocation calculated using the bottom-up methodology implemented in the paper. While investor redemptions are observed throughout the sample period, manager reallocation is important during periods when asset managers heavily invest or divest. This Hungarian case study highlights that manager reallocation flows are particularly important during periods of rapid investment/divestment.

Figure 5: Large Asset Manager Holdings



This figure presents the holdings of sovereign bond from a large asset manager from a selected group of EMs. The horizontal axis present quarters since the acquisition of treasury bonds. The vertical axis represent share of government bond outstanding. Sources: Morningstar, BIS & authors' calculations.

Figure 6: Components of changes in funds' holdings of Hungarian government bonds

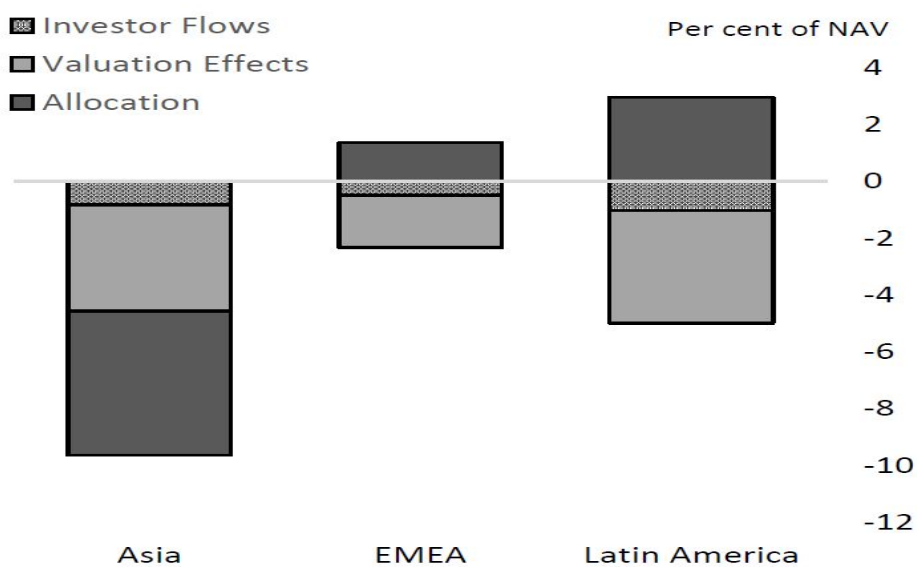


BIS EME debt comparison just includes government debt as this accounts for the vast majority of our funds' holdings of bonds. Sources: Morningstar, Bloomberg & authors calculations.

4.2 Case study of the Taper Tantrum in 2013, Q2 and Q3

Figure 7 shows the change in holdings of EME bonds from each region as a percentage of the fund's NAV, for the median sized fund during the 2013 Taper Tantrum. Investor redemptions (outflows) and valuation effects both reduced the value of funds' holdings of bonds from all three regions. [31] However, notice that manager allocation offset these effects in Latin America and Emerging Europe, Middle East and Africa (EMEA), and contributed a meaningful portion of the fall in holdings of EME Asia bonds. The reasons for the regional differences are beyond the scope of this paper, the key point is the importance of the manager reallocation component. In two cases allocation offset investor outflows, while in one case it added.

Figure 7: Investor flows, valuation effects and reallocation in the 'Taper Tantrum'



Taper Tantrum defined as Q2 & Q3 2013. Chart shows, for the median fund, the change in holdings of bonds from each region as a percentage of the fund's starting NAV. Results are similar if mean is used to define the 'average' fund. Sources: Morningstar, Bloomberg & authors' calculations.

5 Regression results and analysis

5.1 Explaining investor flows and manager reallocation, push and pull factors results

Table 1 presents the results of four different models. Columns 1 and 2 show the results for investor flows as the dependent variable, columns 3 and 4 show the results for manager reallocation. The dependent variable has been scaled by holdings of that

[31] The pattern we identify is consistent with country-level portfolio debt flows data from the IMF, which show foreign capital inflows to Asia were -2% in this period, compared to +2% in EMEA and +10% in Latin America. These statistics include all of the EMEs in our sample, with the exception of Indonesia, South Africa, Malaysia and Russia as there is no IMF data for the quarterly stock of portfolio debt liabilities for these countries.

country's EME bonds in columns 1 and 3, and scaled by the NAV of the fund in columns 2 and 4.

Table 1: Drivers of investor flows and manager reallocation

	Flows (1)	Flows (2)	Reallocation (3)	Reallocation (4)
Global Risk Aversion	−10.64***	−6.46***	1.83***	1.32***
	(0.40)	(0.26)	(0.56)	(0.33)
External Interest Rates	−6.19***	−4.12***	0.21	0.29*
	(0.19)	(0.14)	(0.25)	(0.15)
External Growth	1.29***	0.86***	−0.41**	−0.20*
	(0.11)	(0.07)	(0.20)	(0.12)
Trade Uncertainty	−3.85***	−2.66***	0.27	0.16
	(0.19)	(0.13)	(0.33)	(0.20)
Real GDP Growth	0.40	0.29	1.02***	0.54**
	(0.30)	(0.19)	(0.38)	(0.23)
Real Bond Yields	−0.22	−0.15	0.62**	0.46**
	(0.23)	(0.15)	(0.31)	(0.18)
Credit Rating	−0.65***	−0.43***	−0.05	−0.01
	(0.21)	(0.13)	(0.22)	(0.13)
Debt to GDP	−0.31	−0.09	−1.14	−0.93*
	(0.70)	(0.46)	(0.83)	(0.50)
Reserves to GDP	−1.34**	−0.57	2.48***	1.77***
	(0.62)	(0.40)	(0.84)	(0.49)
Aggregate or Fund?	Fund	Fund	Fund	Fund
Clustered SEs	CountryFund	CountryFund	CountryFund	CountryFund
Fixed Effects	CountryFund	CountryFund	CountryFund	CountryFund
Observations	42,030	42,030	42,030	42,030
R^2	0.09	0.08	0.002	0.002

*p<0.1; **p<0.05; ***p<0.01
This table reports the results of the regressions on the set of push and pull variables presented in 2.1, during the period 2011 to 2017. Definitions, sources and frequency of all independent variables are presented in Annex B. The symbol in parentheses after each independent variable is the expected direction of the coefficient in the model. The columns report the results for the dependent variables as follows. Column (1) shows result for investor-flow driven change in fund's holdings of EME bonds as a percentage of funds' starting holdings of that EME's bonds. Column (2) shows results for investor flow driven change in fund's holdings of EME bonds as a percentage of funds' starting NAV. Column (3) show results for reallocation driven change in fund's holdings of EME bonds as a percentage of funds' starting holdings of EME bonds. Column (4) show results for reallocation driven change in fund's holdings of EME bonds as a percentage of funds' starting NAV. Clustered standard errors on country fund interaction are shown in parentheses.

These results provide evidence that investor flows are strongly responsive to global push factors - changes in global risk aversion, external rates and economic growth, and trade policy uncertainty.[32] The coefficients for these variables are much larger, statistically significant and point in the expected direction for investor flows (columns 1 and 2) when compared to reallocation (columns 3 and 4).[33] However by disentangling fund

[32]These results are in line with analyses of investor flows showing mutual fund flows to EMEs have become more sensitive to the global conditions such as Converse et al. (2020) and Brandao-Marque et al. (2015), among others.

[33]Following Haritou et al. (1995) we use a Z-test to compare the size of the coefficients and standard

manager decisions, we can see that the effects of push factors on manager reallocation partially offset the effects on investor flows. Using our estimates, portfolio manager reallocation decisions would offset around 19% of the global risk aversion effect, 5% of the external interest rate effect and 25% of the external growth effect on investor flows.

The results in Table 1 also provide evidence that manager reallocation decisions are more strongly affected by pull factors. With the exception of credit ratings, the estimated effects of domestic factors (real GDP growth, real bond yields, reserves, and debt to GDP), on reallocation decisions are consistently larger, mostly significant and all point in the expected direction. The results for investor flows are all insignificant, with the exception of credit ratings which for EME investors may attract more consistent attention. The differences in coefficients are again significant (See Annex C in the Appendix for statistical test results.). Previous research suggests that investors and managers exhibit procyclicality, Miyajima and Shim (2014a), Raddatz and Schmukler (2012), Raddatz et al. (2017), Shek et al. (2018). Our analysis of pull factors tells a similar story, and provides evidence that most of the procyclicality comes from managers.

Overall, our results show differentiated effects of push and pull factors on manager reallocation and investor flows. A financial intermediation framework rationalizes these results: investors in the investment fund are delegating to fund managers investment decisions concerning particular EMEs. When making portfolio allocation decisions, fund managers can move between EME bond assets. Fund mandate requirements which explicitly or implicitly limit holdings of EME bonds (e.g. credit rating limits) would likely increase the propensity for intra-EME bond movements.[34] Meanwhile. investors are more sensitive to factors determining their resources, including those global factors affecting their fund's overall performance. The next section delves deeper into the institutional features that may be relevant for mutual fund capital flows.

5.2 Explaining manager reallocation, institutional factors results

The estimation results for equation (2) are presented in Table 2. Models 1 and 3 show results for reallocation scaled by holdings of EME bonds as the dependent variable. Models 2 and 4 show results for the variable scaled by the NAV of the fund. In addition, we show results using two types of approaches, clustering and fixed effects at the country-fund level (models 1 and 2), and at the country-fund-quarter level (models 3

errors of the flow models and the reallocation models. The differences between the results of the two sets of models are all statistically significant at the 10% level, with the exception of that for real GDP growth and debt to GDP. (Tests in Annex C in the Appendix)

[34]For the median fund in our sample, EME bonds account for 20% of their portfolio.

and 4). Results are robust to either specification, with the exception of the derivatives variable which is more precisely estimated when the quarter dimension is included.

Comparing Table 2 to estimates for reallocation in Table 1, the inclusion of institutional factors reinforces our earlier results. Generally pull factors are more important than push factors for manager reallocation decisions, and global risk aversion on average has a positive estimated effect on manager reallocation to EME bonds.

For the new variables, almost all of the estimated effects are statistically significant and in the expected direction. The results for our outflows variable (liquidity proxy), across all models, show an estimated negative coefficient.[35] This implies higher investor outflows are associated with manager reallocation away from EME bonds. This result complements the general argument of Morris et al. (2017): that bond funds sell bonds in order to raise additional cash when redemptions increase. In our model, isolating manager reallocation, the evidence shows that higher outflows is associated with managers selling EME bonds.

With respect to leverage, the estimated coefficient on cash leverage is positive and significant: funds reduce holdings of EME bonds when they reduce their cash leverage. This is evidence that managers sell EME assets in the portfolio in order to deleverage. The evidence of the importance of derivative positions is less strong. The coefficient on this measure of leverage is positive, but imprecisely estimated. Funds reduce holdings of EME bonds when they experience losses on derivative positions. This institutional factor may be less influential because our funds reportedly make limited use of derivatives: derivative positions account for only 1.2% of the gross market value of our sample of funds' portfolios.

With respect to benchmark effects, the estimated coefficients are positive: funds tend to increase holdings of an EME bond when its country share of the GBI-EM or WGBI increases, or if the EME bond becomes eligible for investment grade bond indices. This is consistent with the results of Arslanalp and Tsuda (2015), Raddatz et al. (2017) and Raddatz and Schmukler (2012).

Finally, we find evidence of the hypothesized "safe-haven" effect. In every model, the estimated effect of being a safe-haven EME is positive and statistically significant. fund managers switch towards safer EME bonds when risk aversion is high.

To further examine the drivers of manager reallocation, we estimate our model for three different categories of fund, defined by how invested the fund is in EME sovereign bonds based on their observed portfolios. Fund types are defined as: **High** - funds for who EME bonds account for more than 43% of their portfolio; **Medium** - funds for

[35]The results are robust to instrumenting Outflows with its one quarter lag.

Table 2: Drivers of manager reallocation, including institutional factors

	(1)	(2)	(**3**)	(**4**)
Global Risk Aversion	2.46***	1.91***	2.47***	1.86***
	(0.74)	(0.40)	(0.80)	(0.44)
External Interest Rates	0.13	0.27*	0.24	0.44***
	(0.25)	(0.15)	(0.27)	(0.16)
External Growth	−0.33	−0.17	−0.36*	−0.21*
	(0.20)	(0.12)	(0.21)	(0.12)
Trade Uncertainty	0.22	0.15	0.37	0.31
	(0.33)	(0.20)	(0.38)	(0.23)
Real GDP Growth	0.93**	0.47**	1.14***	0.61**
	(0.38)	(0.22)	(0.39)	(0.24)
Real Bond Yields	0.59*	0.44**	0.37	0.32*
	(0.31)	(0.18)	(0.32)	(0.19)
Credit Rating	−0.11	−0.03	−0.25	−0.15
	(0.23)	(0.13)	(0.24)	(0.14)
Debt to GDP	−1.40*	−1.05**	−1.57*	−1.31**
	(0.84)	(0.51)	(0.87)	(0.51)
Reserves to GDP	2.62***	1.89***	2.71***	1.95***
	(0.84)	(0.50)	(0.86)	(0.51)
Outflows	−1.69***	−0.62**	−2.24***	−0.84***
	(0.54)	(0.25)	(0.55)	(0.27)
Derivative VM	0.16	0.08	0.28*	0.19*
	(0.13)	(0.08)	(0.16)	(0.10)
Leverage Change	0.45***	0.27***	0.43***	0.26***
	(0.12)	(0.07)	(0.14)	(0.09)
Benchmark Change	8.72***	8.67***	8.63***	8.62***
	(2.87)	(2.58)	(2.65)	(2.32)
Inv. Grade Change	2.30**	1.18*	2.31*	1.16
	(1.03)	(0.62)	(1.19)	(0.72)
SafeHaven Effect	0.97**	0.75***	1.28**	0.91***
	(0.47)	(0.25)	(0.51)	(0.27)
Aggregate or Fund?	Fund	Fund	Fund	Fund
Clustered SEs	CountryFund	CountryFund	**CountryFundQuarter**	**CountryFundQuarter**
Fixed Effects	CountryFund	CountryFund	**CountryFundQuarter**	**CountryFundQuarter**
Observations	42,030	42,030	42,030	42,030
R^2	0.004	0.004	0.01	0.01

*p<0.1; **p<0.05; ***p<0.01

This table reports the results of the regressions on the set of push, pull and institutional variables presented in Section 2.2, during the period 2011 to 2017. Definitions, sources and frequency of all independent variables are presented in Annex B. The symbol in parentheses after each independent variable is the expected direction of the coefficient in the model. The columns report the results for the dependent variables as follows. Columns (1) and (3) show results for reallocation driven change in fund's holdings of EME bonds as a percentage of funds' starting holdings of EME bonds. Columns (2) and (4) shows results for reallocation driven change in fund's holdings of EME bonds as a percentage of funds' starting NAV. In Columns (1) and (2) we use country fund interactions as fixed effects, and clustered standard errors on the country fund interaction are shown in parentheses.In Columns (3) and (4) we use country-fund-quarter interactions as fixed effects, and clustered standard errors on the country fund quarter interaction are shown in parentheses.

whom EME bonds account for between 11% and 24% of their portfolio; **Low** - funds for whom EME bonds account for less than 11% of their portfolio. The motivation is that portfolio managers of funds predominantly invested in EMEs may behave differently then those with a more diversified opportunity set, and certain types of funds may be driving our results, in 2.

Splitting the sample, the estimation results are reported in Table 3. In general, the estimated effects are consistent with those for the whole sample, with some notable exceptions. First, the "safe-haven" effect is particularly strong for funds that are highly invested in EME bonds. This is evidence that funds with fewer EME bonds are better able to allocate away from EME bonds to other asset classes during periods of high global risk aversion, while EME focused funds move to the safe EMEs. Also note that the benchmark effects on reallocation, the higher allocation induced when indexes include the EME bonds, are driven by the highly-invested funds. Second, the results in Table 3 also show that the negative coefficient result for Outflows is driven by fund types for whom EME bonds are not their principal asset class. For said funds, EME bonds are amongst the less liquid assets and account for only a minority of the portfolio. Third, for the funds with the low EME holdings, manager allocation to EMEs is unaffected by push factors, including global risk aversion, and among the pull factors only real GDP growth shows evidence of higher EME allocation.

6 Robustness checks

We implement four additional robustness checks. All the variables identified as significant in the reported version of the model remain significant at a confidence interval of at least 90%. These results are available on request.

As a first robustness check, we change the fixed effects used in the models and implement small panel standard error correction. For all models shown in Tables 1 and 2, we have run regressions using country fixed effects, fund fixed effects, quarter-fund fixed effects and quarter-fund-country fixed effects. (All model specifications use Driscoll-Kraay standard errors to control for cross-sectional and temporal dependence structures.) As a second robustness check, we change the data cleaning tolerances we use to weed out potential data imperfections. Specifically, we run the regressions on data prepared using tighter cleaning tolerances (which reduce the sample size by a third). As a third robustness check, we implement an instrumental variable regression, using lags of our Outflow variable as instruments. Our model assumes that manager reallocation decisions are driven by investor flow decisions. It could be the reverse where investors respond to manager reallocation. Although most funds only publish

Table 3: Drivers of reallocation, including institutional factors by type of fund

	High (1)	Medium (1)	Low (1)	High (2)	Medium (2)	Low (2)
Global Risk Aversion	3.75***	1.89**	0.34	4.50***	2.86**	0.24
	(0.86)	(0.79)	(0.45)	(1.04)	(1.24)	(1.32)
External Interest Rates	0.97***	−0.02	−0.19	1.17***	−0.20	−0.58
	(0.33)	(0.29)	(0.15)	(0.40)	(0.46)	(0.46)
External Growth	−0.23	−0.17	−0.16	−0.16	−0.32	−0.57
	(0.26)	(0.22)	(0.12)	(0.32)	(0.35)	(0.36)
Trade Uncertainty	−0.18	0.32	0.29	−0.14	0.30	0.58
	(0.46)	(0.33)	(0.22)	(0.54)	(0.54)	(0.67)
Real GDP Growth	0.53	0.40	0.55**	0.51	0.68	1.62**
	(0.46)	(0.41)	(0.22)	(0.57)	(0.68)	(0.70)
Real Bond Yields	0.60*	0.65*	−0.03	0.72*	0.95*	0.04
	(0.33)	(0.36)	(0.20)	(0.40)	(0.58)	(0.61)
Credit Rating	0.04	0.13	−0.22	0.10	0.37	−0.62
	(0.27)	(0.24)	(0.14)	(0.33)	(0.39)	(0.43)
Debt to GDP	−2.79***	−0.28	0.01	−3.26**	−0.39	−0.30
	(1.08)	(0.86)	(0.47)	(1.29)	(1.42)	(1.50)
Reserves to GDP	3.10***	2.47***	0.20	3.85***	4.11***	0.73
	(0.98)	(0.84)	(0.49)	(1.16)	(1.34)	(1.67)
Outflows	−0.03	−0.79	−0.93***	−0.03	−1.61*	−2.93***
	(0.56)	(0.55)	(0.26)	(0.70)	(0.94)	(0.98)
Derivative VM	−0.03	0.20*	0.06	−0.002	0.33*	0.17
	(0.21)	(0.12)	(0.09)	(0.23)	(0.20)	(0.26)
Leverage Change	0.30*	0.23**	0.25***	0.32*	0.31**	0.80***
	(0.16)	(0.10)	(0.10)	(0.18)	(0.15)	(0.30)
Benchmark Change	9.59***	−2.18		9.99***	−4.35	
	(2.58)	(4.01)		(2.83)	(6.34)	
Inv. Grade Change	1.55	0.73	1.12	2.04	1.77	3.09
	(1.20)	(1.17)	(0.71)	(1.43)	(1.89)	(2.02)
Safe Haven Effect	1.50***	0.61	0.30	1.68**	0.73	0.42
	(0.55)	(0.53)	(0.28)	(0.66)	(0.83)	(0.86)
Clustered SEs	CountryFund	CountryFund	CountryFund	CountryFund	CountryFund	CountryFund
Fixed Effects	CountryFund	CountryFund	CountryFund	CountryFund	CountryFund	CountryFund
Observations	13,941	13,806	14,283	13,941	13,806	14,283
R^2	0.01	0.004	0.01	0.01	0.004	0.01

*p<0.1; **p<0.05; ***p<0.01
This reports the results of the same regression models on the set of push, pull and institutional variables as presented in Section 3, during the same period of 2011 to 2017, by fund type. Definitions, sources and frequency of all independent variables are presented in Annex 3. The dependent variable is manager-reallocation driven change in fund's holdings of EME bonds; for the first three columns as a percentage of funds' starting holdings of EME bonds, for the last three columns as a percentage of funds' starting NAV.
Fund types are defined as: **High** - funds for who EME bonds account for more than 43% of their portfolio; **Medium** - funds for whom EME bonds account for between 11% and 24% of their portfolio; **Low** - funds for whom EME bonds account for less than 11% of their portfolio.

full holdings quarterly, some publish monthly summaries of portfolio allocations. It may be that investors note changes in manager allocation in the monthly report and then decide to redeem or subscribe before end quarter.

As a fourth robustness check, we change the construction of the "safe-haven" variable. To generate our safe-haven score we chose: the criteria on which to assess "safeness"; the metrics on which to score each country according to these criteria; and the method by which to weight these metrics. Mexico, Korea and Poland consistently emerge as relative "safe-havens" irrespective of how we exercise our discretion. For example, these three countries remain in the top-4 of our rankings if we drop any one of our five criteria completely. They remain the top-3 if we change our weighting methodology as well. The only country that ranks amongst Poland, Korea and Mexico under certain designs of the variable is Malaysia. Results are robust to running the regressions including Malaysia as a "safe-haven".

7 Conclusions and implications

By disentangling two components of mutual fund capital flows to EMEs, (i) investor flows and (ii) manager reallocation, this paper assesses the drivers of each component and analyses the role of institutional features of the mutual fund channel. Our result show that both investor flows and manager reallocation are important for portfolio flow dynamics and are not always in the same direction. We find differentiated effects of push and pull factors on investor flows versus manager reallocation, push factors are more relevant for investors, pull factors for fund managers. Finally, we present evidence of the importance of institutional factors, including the "safe-haven" effect, as drivers of manager allocation decisions.

It is important to note that our bottom-up methodology for calculating investor flows at the fund level, and manager allocation at the asset level, exploits the most granular portfolio data available, at the security level. However, as discussed in the text, there are limitations due to the quality of the underlying micro-data and the extensive data cleaning required. Also, our sample is for 2011-2017, and we do not study dynamics before the Global Financial Crisis. Future research could examine this period, as well as provide in-depth analyses of episodes of global importance, such as the dramatic spike in trade tensions during 2016-17, or the Russian invasion of Ukraine. Nevertheless, this research hopefully prompts a refocus of the role of fund managers, and the special features of investment funds.

For example, our results have implications for analyses of capital flows to EMEs, and could be integrated into analyses of financial stability risks posed by mutual funds more generally. Four factors can be take into account when assessing the risk of sudden surges and reversals in capital flows channeled by investment funds. First, the percentage of bonds held in open-ended funds (OEFs) should be considered given that investors can redeem at short-notice, and investors in these funds tend to be more responsive to push factors, they subscribe/redeem from funds when global conditions improve/deteriorate. Second, take into account the percentage of bonds held in funds which have the option to divest/reallocate. All open-ended funds (OEFs) are exposed to investor flow risk, but only certain types of funds can reallocate. Funds which invest only in one country's bonds, for example, cannot. Therefore, the greater the proportion of a countries' assets which are held in non-domestic, active funds with broad investment mandates – the greater the risk of reallocation, and thus the greater sensitivity to changes in pull (domestic) factors. Third, consider whether the EME is a plausible safe haven as less "safe" EMEs are more sensitive to increases in global risk aversion as fund managers switch towards safer EMEs. And, with respect to the type of fund, track the percentage of bonds held by fund managers with higher or lower exposure to EMEs overall. The more invested the fund is in EMEs, the stronger the "safe-haven" effect.

Looking across these metrics our analysis suggests some EMEs are more vulnerable than others to fund manager reallocation outflows (Annex D). Peru scores highly on all four measures, for example.

Allocation decisions are also relevant to analyses of the role of mutual funds in financial markets more generally. As discussed above, financial stability policymakers and researchers have focused on risks related to funds fire selling assets in order to meet investor redemptions (redemption risk). However, we show that manager reallocation decisions are often a more significant driver of individual EME bond sales than investor flows, particularly in stress periods. As such, reallocation decisions are important to the analyses of fire-selling by mutual funds, and system-wide stress testing tools which model the behaviour of financial market participants (e.g.Calimani et al. (2017), Aikman et al. (2019)).

With regards to the institutional features of investment funds, some participants highlight that the pooling of assets in funds may actually reduce the risk of redemption-driven fire-sales ((Blackrock, 2014)), since investment funds have tools to discourage/prevent redemptions by investors. If, instead, investors invested in assets directly, there would not be barriers to their selling off an asset. Nevertheless, investment funds concentrate decision making power regarding reallocation decisions. Individual investors would be unlikely to coordinate and simultaneously switch from one asset to another, but asset managers can make such a decision on their collective behalf.[36] Returning to our earlier Hungary example (see Figure 6), it seems unlikely that individual investors would have simultaneously chosen to sell 15% of the country's government bonds. Thus while investor redemption risks may be mitigated by redemption restrictions, fund manager reallocation risks can be particularly relevant for a country's capital flows.

[36] For example, the Norwegian government announced the removal of EME bonds from the benchmark of their Government Pension Fund (Norway Ministry of Finance, 2019). We estimate this could lead to sales of around USD9bn of EME bonds.

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A Annex: Descriptive Statistics

Figure 8: Number of funds and managers

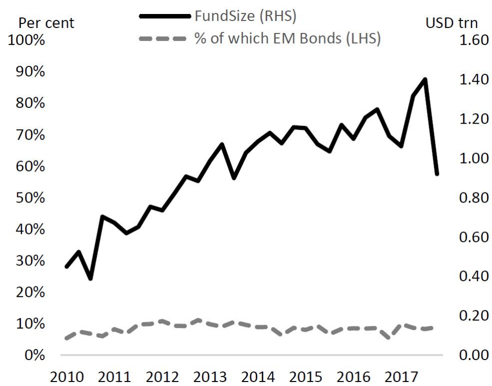


Figure 9: Fund size, % of which EME bonds

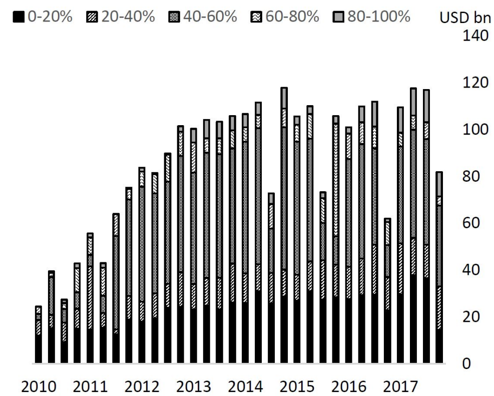


Figure 10: EME bonds, by type.

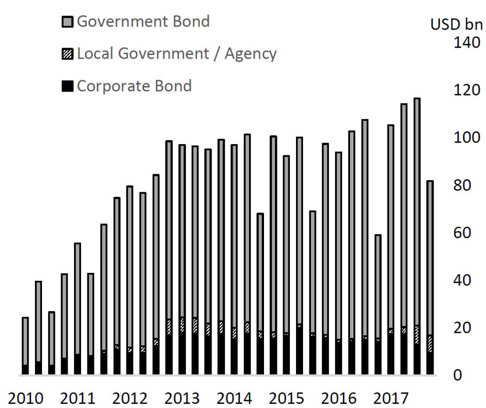


Figure 11: EME bonds, by % of fund's portfolio in EME bonds

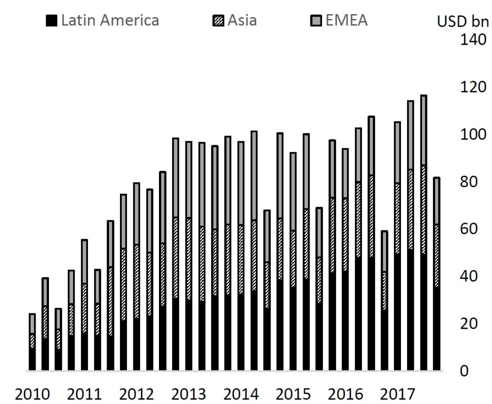


Figure 12: Estimated country coverage, end-2017

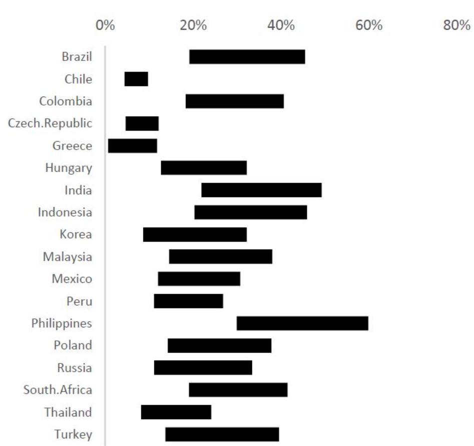
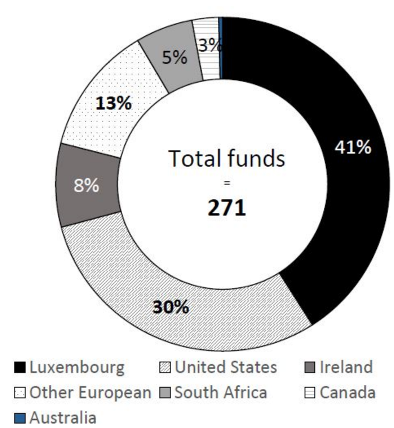


Figure 13: Domicile of funds.



B Annex: Independent Variables

Variable	Definitions / Calculations	Source
Global Risk Aversion	Federal Reserve Bank of Kansas City Financial Stress Index	Federal Reserve Bank of Kansas City
External interest rates	Annual yield on 10 year United States government bonds less annual inflation in the United States.	Bloomberg, IMF and author calculations.
External growth	Annual real GDP growth rate for the United States.	IMF and author calculations
Trade Uncertainty	US categorical Trade Policy Uncertainty index based on searching US news sources for terms relating to trade and uncertainty.	https://www.policyuncertainty.com/us_monthly.html
Real GDP growth rate	Difference between the annual real GDP growth rate for EME and the average annual real GDP growth rate for our sample of EMEs.	IMF and author calculations
Real bond yields	Difference between annual yield on 10 year government bonds for each EME (less annual inflation) and the average real yield for our sample of EMEs.	Bloomberg, IMF and author calculations.
Credit Rating	Difference between credit rating of each EME and average credit rating for our sample of EMEs. Each rating is given a number from 21 (for AAA) to 1 (for Defaulted)	S&P and author calculations
Debt to GDP	Difference between total government debt as a proportion of nominal GDP for each EME, and the EME average debt to GDP ratio.	BIS, IMF and author calculations
Reserves to GDP	Difference between reserves (excluding gold) as a proportion of nominal GDP for each EME, and the average EME reserve to GDP ratio.	IMF and author calculations
Outflows	Negative change in the net-asset-value of a fund not explained by changes in asset values or FX effects	Morningstar and author calculations
Derivative VM	Change in the market value of derivative assets held by the fund	Morningstar and author calculations
Leverage change	Change in the ratio of gross-asset-value to net-asset-value for the fund	Morningstar and author calculations
Benchmark change	Change in the weighting of a country in JP Morgans GBI-EM bond index or FTSE's WGBI index	Arslanalp and Tsuda (2015), FTSE-Russell and author calculations
Upgrade or Downgrade	Upgrade or downgrade of a government's bonds to or from investment grade rating	S&P and author calculations.
SafeHaven effect	Dummy of 1 for Korea, Mexico and Poland (and -1 for all other EMEs) multiplied by difference in Global risk aversion metric from its historic median value.	Federal Reserve Bank of Kansas City and author calculations. See Annex B.1 for determinants of dummy variables for countries.

B.1 Metrics used to calculate safe-haven variable

Criteria	Bond Market Depth		Hedging Market Size		Market Infrastructure & Accessibility				Default	Volatility	
Metric	Bond Turnover	Market Size	Rates Turnover	FX Turnover	Market Openness	IMF fin markets	Local Dealers	Chinn Ito	Ratings	Largest Qly loss	Correlation with USTs
Units	USD bn	USD bn	USD bn	USD bn	Average Score	0 to 1	USD bn	0 to 1	AAA to D	Basis Points	Per cent
Korea	1600	646	3188	21128	1.06	0.87	54	1.0	AA	87	62%
Mexico	1612	415	6434	24458	1.56	0.35	22	0.7	BBB+	167	65%
Poland	774	243	1394	8901	1.56	0.34	11	0.7	A-	137	40%
Malaysia	162	179	786	4559	1.67	0.65	8	0.4	A-	92	49%
Thailand	566	139	537	4596	1.4	0.6	11	0.2	BBB+	96	37%
India	1305	510	1425	14604	0.9	0.5	36	0.2	BBB-	182	14%
South Africa	640	188	4069	12422	1.8	0.5	30	0.2	BB	205	35%
Czech Republic	21	80	345	3587	1.6	0.2	4	1.0	AA-	121	56%
Brazil	2211	1443	1662	12773	1.2	0.5	21	0.2	BB-	434	5%
Chile	33	70	1056	3141	1.3	0.4	8	0.7	A+	164	11%
Philippines	NA	114	6	1774	1.3	0.4	3	0.4	BBB+	148	62%
Hungary	166	100	1927	3855	1.6	0.3	3	1.0	BBB	239	16%
Indonesia	352	225	56	2543	1.5	0.3	5	0.4	BBB-	297	60%
Turkey	NA	189	12	18349	1.4	0.5	22	0.4	B+	903	34%
Russia	112	162	31	14635	1.1	0.4	45	0.7	BBB-	636	-20%
Colombia	NA	126	356	1990	1.1	0.3	4	0.4	BBB-	253	34%
Peru	NA	38	4	977	1.3	0.3	1	1.0	BBB+	173	4%
Pakistan	197	111	NA	NA	1	0	NA	0	B-	400	5%
Sources	Various*	BIS and RBI	BIS	BIS	MSCI*	Svirydzenka (2016)*	BIS*	Chinn and Ito (2006)	S&P	Bloom berg*	Bloom berg*

Tables shows the latest data available for each metric. See following page for notes on how the starred metrics have been constructed

Footnotes to Safe-haven table B.1

Bond Turnover data has been collated on a best endeavours basis from various sources. Where possible we have sought to ensure the two legs of a trade are not double counted, and we have also sought to exclude repo. Sources are: ACRA, Asian Development Bank, Bank of Mexico, CEIC, Central Bank of Brazil, Central Bank of Chile, Clearing Corporation of India, Hungarian Government Debt Management Agency (AKK), Johannesburg Stock Exchange, Polish Ministry of Finance, Prague Stock Exchange, South African National Treasury, State Bank of Pakistan, TKB BNP Paribas Investment Partners, World Bank Group.

MSCI, in their regular Global Market Accessibility Review, assess the market accessibility of countries using 18 criteria. For each criteria they give a judgement of "no issues", "no major issues, improvements possible" and "improvements needed / extent to be assessed". We convert these judgements into a score of 2, 1 and 0 respectively, and then take the average for each country to create a market accessibility score.

Svirydzenka, 2016 scores countries on their financial development, based on six criteria. We show the scores for one of these criteria – financial market access – in the table.

Local dealers refers to the value of Interest rate and FX derivative contracts written in each respective country, according to BIS Triennial derivative survey data.

Quarterly Loss refers to the largest 90-day change in yield on the generic 10 year government bond for each country between January 2010 and July 2019.

Correlation with UST refers to the correlation, between January 2010 and July 2019, between the yield on the generic 10 year government for each country and the generic 10 year US Treasury bond. We use daily data.

C Annex: Z-test results for regression analyses

Following Haritou et al. (1995) we use the following Z-test to compare the size of the coefficients in two models. β_i, refers to the relevant coefficient from the first model, and β_j to the relevant coefficient from the second model. SE refers to the standard error on the coefficient.

$$Z = \frac{\beta_i - \beta_j}{\sqrt{SE\beta_i^2 + SE\beta_j^2}}$$

Comparison 1: Comparing the results of Models 1 and 3 in Table 1

	term	Score	Prob
1	Global Risk Aversion	-19.71	0.00
2	External Rates	-23.00	0.00
3	External Growth	7.45	0.00
4	Trade Uncertainty	-10.51	0.00
5	Real GDP Growth	-1.35	0.15
6	Real Bond Yields	-2.37	0.02
7	Credit Rating	-2.41	0.02
8	Debt to GDP	0.93	0.35
9	Reserves to GDP	-4.29	0.00

Comparison 2: Comparing results of Models 2 and 4 in Table 1

	term	Score	Prob
1	Global Risk Aversion	-20.38	0.00
2	External Rates	-26.29	0.00
3	External Growth	7.80	0.00
4	Trade Uncertainty	-4.35	0.00
5	Real GDP Growth	-0.93	0.34
6	Real Bond Yields	-2.80	0.00
7	Credit Rating	-2.79	0.01
8	Debt to GDP	1.57	0.12
9	Reserves to GDP	-4.35	0.00

D Annex: Vulnerability arising from global mutual funds

Country	Redemption risk: Sovereign bonds in [global?] OEFs	Redemption and Reallocation risks: Sovereign bonds in OEFs with discretion to divest	Concentration issue: Largest manager's share of OEFs with discretion to divest	Calculated Safe Haven score. See Table B.1	Average rank across four vulnerability metrics
Peru	31%	31%	17%	29%	2
Brazil[a]	90%	37%	27%	48%	3
Indonesia	22%	21%	16%	39%	5
Colombia	19%	19%	9%	33%	7
Mexico	30%	25%	16%	75%	8
Greece	15%	15%	12%	44%	8
Chile	20%	19%	9%	52%	9
South Africa	23%	22%	5%	50%	9
Russia	15%	15%	5%	42%	10
Turkey	14%	13%	11%	44%	10
Thailand	11%	11%	16%	55%	11
India	7%	7%	25%	48%	11
Czech Republic	11%	11%	11%	60%	12
Hungary	11%	11%	8%	51%	12
Philippines	6%	6%	13%	40%	12
Korea	8%	7%	16%	91%	14
Malaysia	8%	8%	6%	63%	15
Poland	9%	8%	5%	68%	15

Sources: Morningstar, BIS and authors' calculations. [a] The share of Brazilian sovereign bonds held in OEFs is high for two reasons: (i) around 75% of Brazilian pension fund assets are in mutual funds(Central Bank of Brazil, 2018), (ii) this data includes repo positions backed by sovereign debt.

E Annex: Comparing mutual funds to all overseas investors

Table 4: Changes in holdings of EME portfolio debt in response to push/pull factors

	(1) All Overseas Investors	(2) Mutual Funds
Global Risk Aversion	-8.90^{***}	-7.56
	(2.69)	(5.61)
External Interest Rates	-7.81^{***}	-12.28^{***}
	(1.66)	(2.88)
External Growth	-0.17	-1.72
	(1.42)	(2.03)
Real GDP Growth	2.25	-1.58
	(1.85)	(3.41)
Real Bond Yields	3.99^{**}	4.93
	(1.75)	(3.67)
Credit Rating	0.39	2.93
	(2.09)	(2.20)
Debt to GDP	-1.35	-6.76
	(8.72)	(8.04)
Reserves to GDP	8.60^{**}	18.05^{*}
	(4.36)	(9.22)
Aggregate or Fund?	Aggregate	Aggregate
Clustered SEs	Country	Country
Country Fixed Effects	Yes	Yes
Observations	433	433
R^2	0.09	0.11

Covers the period 2011 to 2017. Definitions and sources for all independent variables are presented in Annex B and discussed in Section 2.1 . The symbol in parentheses after each independent variable is the expected direction of the coefficient in the model. Column (1) reports the results where gross portfolio debt inflows as a percentage of foreign portfolio debt liabilities is used as dependent variable. This represents all overseas investors, and is calculated using IMF data. Column (2) report the results where (non-valuation) changes in funds' holdings of EME bonds as a percentage of funds' starting holdings of EME bonds is used as dependent variable. This is calculated using Morningstar data, with the sample the same as that described in Section 3 of the paper. Robust standard errors are in parentheses. Statistical significance $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

F Annex: Disentangling investor flows and manager reallocation using security-level data

We exploit granular security-level data, by ISIN, on funds' portfolios to be able to calculate the exact price changes and FX effects experienced by funds. This means we do not mis-estimate valuation effects for funds whose portfolios do not match the country bond index (say because they invest in shorter-duration bonds or more hard-currency bonds). With this more precise estimate of valuation effects we can better analyse the residual changes in asset values, and thus portfolio flows.

After downloading and cleaning fund portfolio security-level data, we proceed to calculate for each security held in the portfolio, bond or equity, the price and currency effects on the value of the fund's overall holdings of that security.

First, the change in the market price of each asset k in each portfolio between each quarter is calculated using one of seven pricing approaches. These approaches are set out in Figure 15, in order of their precision. We are able to apply the most precise approach for around two-thirds of portfolio assets (and three-quarters of fund's bond assets). For these assets, we know the exact market price of the security used by the fund to calculate the fund's NAV at end-quarter. It is not possible to price all assets in this way, typically because they (i) don't have a unique ISIN which can track between quarters, (ii) the fund sells the asset between periods or (iii) the asset matures between quarters. In these situations, we use one of the six other less-precise pricing approaches.

Second, after pricing the securities, we calculate the change in the USD value of the asset between quarters. Here, we apply a quarterly exchange rate change calculated using Bloomberg. **Valuation changes** ($VC_{k,t}$) for asset k are thus comprised of changes in the market prices of the asset and changes in relevant exchange rates, as set out in equation (3). For each asset k, AV_k is the total portfolio value of asset k in USD, AS_k is the number of shares the fund holds of that asset, and AC_k is the currency of that asset. Thus total valuation changes for fund j at time t are $\sum_{k \in j} VC_{k,t}$.

$$VC_{k,t} = AV_{k,t-1}\left(\frac{AV_{k,t}/AS_{k,t}}{AV_{k,t-1}/AS_{k,t-1}} - 1\right) + AV_{k,t-1}\left(\frac{AC_{k,t}/USD_t}{AC_{k,t-1}/USD_{t-1}} - 1\right) \tag{3}$$

We then calculate what we call **investor flows** ($IF_{j,t}$) for fund j as defined in equation (4), where PV is portfolio value (or NAV). Any change in portfolio value not due to price and FX changes, we call investor flows. This is a calculated measure that proxies for what we cannot observe directly. Furthermore, its accuracy depends on our underlying security level data.

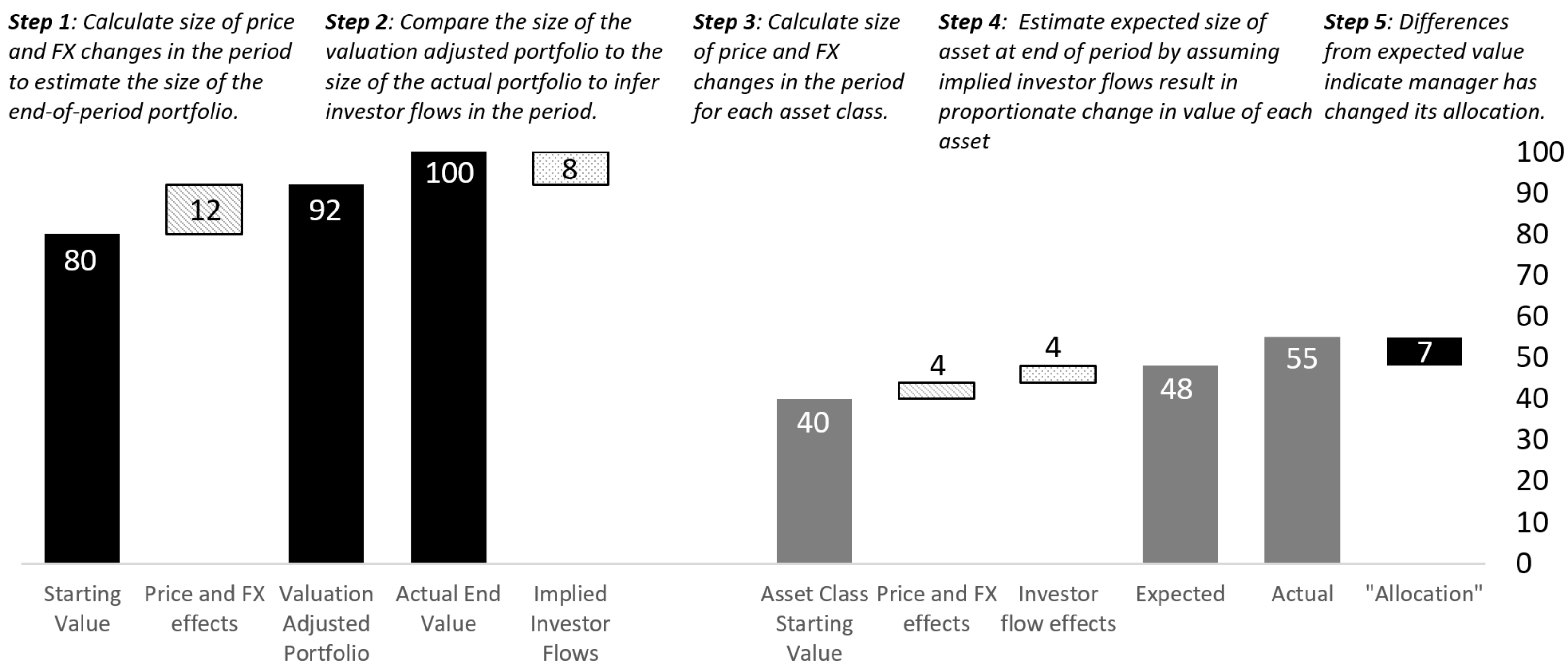
$$IF_{j,t} = PV_{j,t} - \left(PV_{j,t-1} + \sum_{k \in j} VC_{k,t})\right) \tag{4}$$

Our definition of manager reallocation is defined for asset k in equation 5. The change in the value of the fund's holdings of asset k, AV, not accounted for by valuation changes and investor flows, we accrue to portfolio **manager reallocation** ($MA_{j,k,t}$).

$$MA_{j,k,t} = AV_{j,k,t} - AV_{j,k,t-1}(1 + VC_{j,k,t}) - AV_{j,k,t-1}\left(\frac{IF_{j,t}}{PV_{j,t-1}}\right) \tag{5}$$

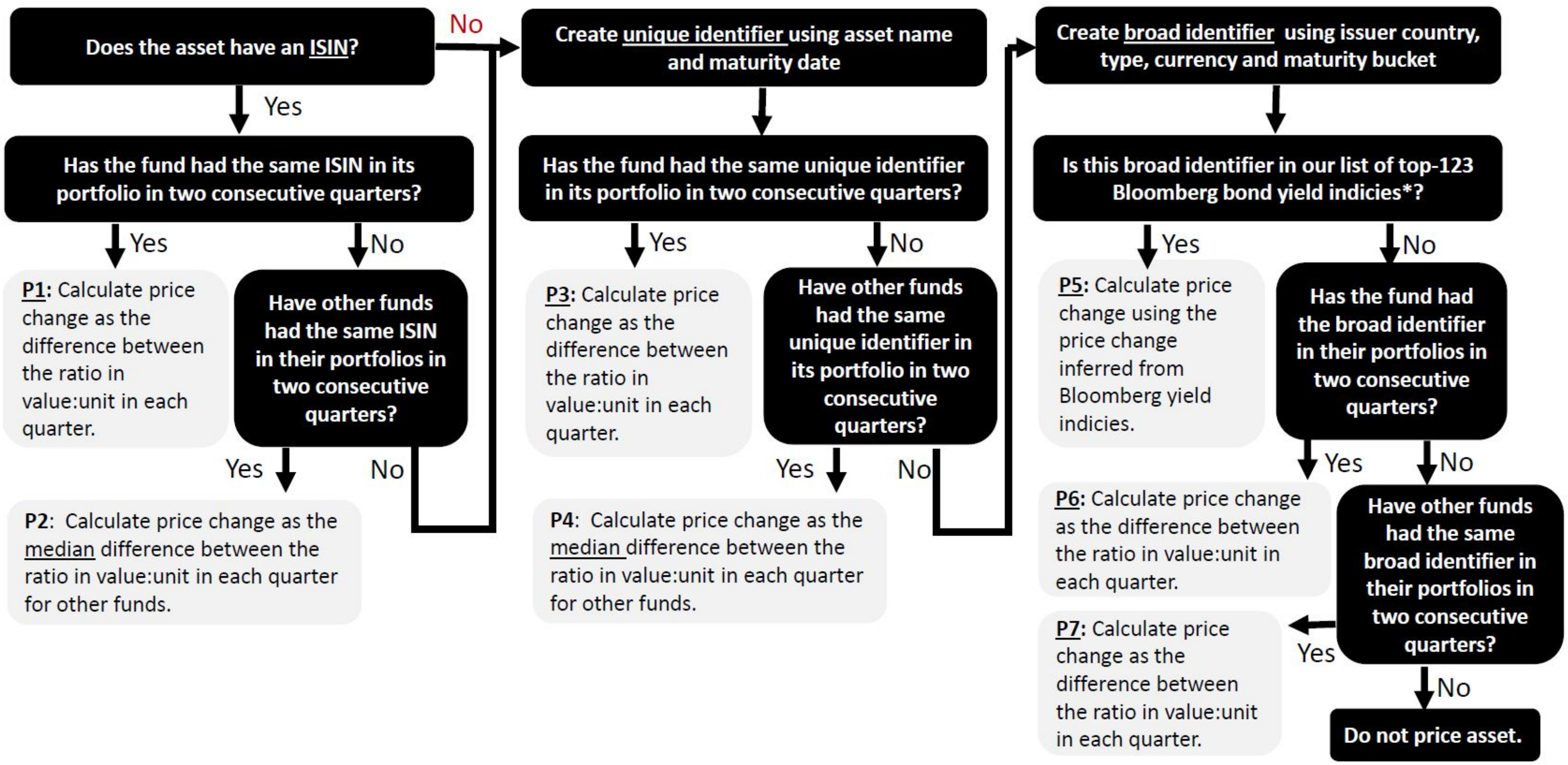
Figure 14 describes the intuition behind our definitions. Security level data enables us to quantify valuation effects: that is, the impact of price and FX changes on a fund's portfolio over a period. By comparing the size of their valuation-adjusted portfolio at the end of a period to the reported size of the portfolio, we can infer changes in the amount investors have invested in the fund over that period (investor flows). We can then calculate, for each asset, what its portfolio value would have been at the end of the period had the manager not changed their allocation. That is, had investor flows resulted in a proportionate change in the AV of each security (i.e. 10% investor outflows results in a 10% fall in the holdings of each asset in the portfolio). Any difference between this expected value and the observed value indicates that the manager has changed how it allocates its capital.

Figure 14: Calculating investor flows and manager reallocation



Pricing Approaches

Figure 15: Approach for pricing assets within our dataset



For the most common government bonds in our dataset we download quarterly yield data for 1-year, 3-year, 5-year and 10-year from Bloomberg where it is available. We then convert quarterly changes in yields to quarterly changes in price calculating each bonds modified duration under the assumption that bonds pay coupons semi annually. For government bonds in our dataset we are unable to price using measures P1-P4, we apply which ever of these constructed pricing series is closest in maturity. We price around 2% of assets in this way.

Additional data cleaning

Once we have applied our methodology for computing investor flows and manager reallocation, we clean the data further. First, we remove the quarterly-report for a fund if we are unable to calculate exchange-rate or price effects for more than 20% of their investments.[37] If we are unable to price a material proportion of securities in a portfolio, then we will inaccurately estimate portfolio flows and reallocation for individual securities.

Second, we remove the quarterly-report for a fund if the change in the total value of their assets is more than 15% different from the change in their reported net asset value (NAV).[38] These differences are rare and often due to the misreporting of a single security. This gives the impression of a larger-than-actual change in the holdings of that security, which our methodology would falsely attribute to reallocation decisions (as the change can't be explained through valuation effects or investor flows).

Third, we remove the quarterly report for a fund if there is a material change in assets for which portfolio data is not available. The funds' reported NAV is occasionally larger than the total value of assets for which we have ISIN level data. We treat these differences as "missing assets". When missing assets account for more than 33% of either total positive or negative reallocation decisions for the fund, we remove the fund quarterly report. Fourth, we remove the quarterly report for a fund if investor inflows exceed 20%. This is designed to capture funds which have been recently established and are expanding their NAV rapidly. Including such funds would bias our results when later analysing which factors determine investor flows.

Fifth, we remove the quarterly report for a fund where there is more than a 5% difference between our calculation and Morningstar's calculation for investor flows. Like us, Morningstar estimates investor flows for each fund by subtracting total net assets at the end of a period from total net assets at the start of the period, once adjusted for valuation effects. But Morningstar use daily and monthly data to calculate investor flows, whereas we use quarterly data. And they use portfolio-wide returns data provided by fund managers, whereas we use asset-by-asset returns inferred from quarterly portfolio changes. This given, Morningstar's estimates for investor flows will be more accurate, if still imperfect. We don't eliminate all but exact matches from our dataset as, given the above methodological differences, there will always be small differences in estimates for flows.[39]

[37]We assume that, unless otherwise specified, cash securities are denominated in the base currency of the fund.

[38]Net asset value of a mutual fund is its trading price and set at the end of each day. It is defined as the assets of the fund (end of the day market value of its securities, cash and cash equivalents, plus any receivables and accrued income) minus its liabilities (lending received from banks, pending payments such as fees and charges, and all accrued operating expenses such as marketing and employee salaries).

[39]This leaves us with a large sample size, and the data looks reliable: regressing our implied flows against Morningstar estimated flows gives an R-squared of 96.4%.

G Annex: Transformation of investor flows and manager reallocation variables

To adresss the leptokurtic distribution of these data, we transform the dependent variables prior to undertaking regression analysis. To identify the most effective transformation, for each model we calculate standardised residuals using a range of transformed dependent variables, following Tukey's Ladder of Transformations (Tukey, 1977). Specifically, for each model we try the following four different power transformations that are appropriate for heavy-tailed data:

λ	$\frac{1}{3}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{2}{3}$	1
y	$\sqrt[3]{x}$	$\sqrt[2.5]{x}$	$\sqrt{x}$	$\sqrt[1.5]{x}$	x

To ensure our data is symmetric, we subtract each value from the median (in most case the median is very close to zero anyway). And, as we have both positive and negative values in our dataset, we apply the power transformation to the absolute value of the variable, before multiplying it by its original sign (as discussed in Cox (2011)). So the full transformation is as follows.

$$y_i = sgn(x_i) * |x_i - median(x))|^\lambda$$

We then split the models into those which use aggregated fund data and those which use individual fund. For each of these two groups, we find which transformation gives the lowest average Jarque-Bera score. We use Jarque-Bera rather than other normality tests as it is appropriate for large datasets and relatively effective when used with long-tailed datasets (Yap and Sim, 2011).

For the model using aggregated fund data shown in Annex E, this process suggests the most effective transformation is a square-root transformation. For the remaining models using individual fund data the most effective is a cube root transformation. Using the same transformations ensures the results are still comparable within these two groups.

These transformations ensure residuals are broadly normally distributed (qq-plots are available on request).