Meeting investor outflows in Czech bond and equity funds: horizontal or vertical?

Milan Szabo

Abstract

This paper explores liquidity management practices in Czech open-ended bond and equity funds. I reconstruct cash flows stemming from investors and securities, and cash flows related to purchases and sales in portfolios and margin calls to study liquidity transformation and liquidity management in investment funds. I study how portfolio illiquidity and current market conditions influence the joint behavior between investor redemptions and funds’ liquidity management. I point to a strong propensity to reduce the liquid buffers rather than sales of securities to meet redemptions in bond funds. The propensity increases with portfolio illiquidity. I show equity funds historically tended to dash for cash in response to investor redemptions during a severe market turmoil.

Keywords

Investment fund · Liquidity management · Liquidity transformation

JEL Classification

G11 · G23 · G30

1 Introduction

It is well known that the daily redeemability of open-ended funds, coupled with the assets in funds’ portfolios of various liquidity, effectively leads to liquidity transformation. While the liquidity transformation carried out by investment funds serves an important economic function, it comes with risks to financial stability. Indeed, since investors can redeem on any trading day based on the most recent net asset...
value (NAV), the costly adjustments of funds’ portfolios due to the redemptions may be reflected to a large extent in future NAV and borne by the remaining investors, potentially leading to the first-mover advantage. What is more, the way the asset manager meets the outflows can strengthen the first-mover advantage as demonstrated in a theoretical model by Zeng (2017). Therefore, understanding the liquidity management practices employed by funds’ asset managers when facing investor redemptions is important for mapping risks to financial stability, building stress tests, and navigating regulatory and macroprudential tools.1

There are two broad strategies that funds may follow to meet investor redemptions: “horizontal cut” and “vertical cut”. In the horizontal cut, the portfolio manager liquidates cash and liquid assets first to save on trading costs associated with investor outflows. Simultaneously, this practice increases relative exposures to illiquid assets for the remaining investors. On the other hand, if a fund engages in vertical cutting, it scales down the fund’s assets proportionately. This, however, may induce trading costs. Unless funds appropriately charge the corresponding costs to the exiting investors, the expected dilution of the fund can prompt the remaining investors to redeem their shares.

Using detailed data for Czech open-ended bond and equity funds, I show that there is a strong propensity to reduce liquid buffers rather than sell securities to meet redemptions in bond funds. Importantly, this propensity increases after one takes the illiquidity of funds’ bond holdings into account. Such a strategy may increase vulnerabilities in the system due to the negative externalities for the remaining investors. Equity funds deplete their liquid buffers less aggressively than the bond funds studied. This might be due to the higher market liquidity in equities than bonds. The limited relationship found between the choice of strategy and the portfolio liquidity for the studied equity funds can be taken as additional evidence that this might be the case. I also show that liquidity management practices are considerably different under stressed market conditions. I track a large propensity to reduce cash balances in bond funds during stress periods, when market liquidity is low and uncertainty is high. For equity funds, I show that historically they have tended to dash for cash in response to investor redemptions during severe market turmoil.

This paper contributes to the literature in at least three respects. Firstly, it focuses on funds from a less developed market rather than on funds from advanced markets (such as the U.S.), which have been studied relatively extensively. I aim to fill this void, as it is interesting in terms of portfolios of the investment funds studied and their investor base. The funds studied usually invest in assets from less liquid emerging markets, and their investors can have different sensitivity to funds’ performance stemming from different wealth, risk appetites, and possibly financial literacy.2

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1 See Cominetta et al. (2018) or de Guindos (2020).
2 Investors in more developed countries may be more familiar with financial products owing to the greater development and age of their financial markets, and also because those markets are larger and more pervasive in their countries. For instance, Khorana et al. (2005) found larger fund industries in countries with wealthier and more educated populations. Fareira et al. (2012) demonstrated the need to go beyond advanced U.S. markets by studying equity funds in 28 countries and showing that the classical flow-performance relationship previously found for the U.S. data does not apply universally.
Finally, I motivate the need to contribute to the rather “U.S.-centric” literature by the staggering growth of the investment fund sector in some EMs, such as the Czech Republic, Chile, and many others.\(^3\) Despite this rapid growth, empirical research of the vulnerability mechanics and risks stemming from the sector in less developed markets is very scarce.

The second contribution lies in the uniquely compiled dataset, which tracks funds’ portfolios and related cash flows at monthly frequency. The unique reconstruction identifies cash flows stemming from: investor inflows and outflows, purchases and sales of securities, inflows from securities (such as dividends, coupons, and maturities), and other inflows (such as margin calls). It provides a detailed picture of the fund’s liquidity and its use. I employ the reconstructed flows to identify liquidity management practices in a natural and easily interpretable way. I also provide results based on reported gross investor flows rather than net investor flows that are usually built from the error-prone return-adjusted approximation.\(^4\) Such data advantage is relatively rare in the literature, and, as far as I know, unique to the study of liquidity management practices in funds.

Thirdly, thanks to the detailed reconstruction of cash flows, I contribute by identifying pure “liquidity need” episodes for the funds studied, i.e., months when the fund had to choose which part of its assets to liquidate, since its total outflows were greater than its total cash inflows. I thus contribute to the literature by reporting results on funds’ strategies that are not biased by the “steady-state”, business as usual, behavior, but are built upon the decisions fund managers had to take during a true liquidity squeeze. Such results are more insightful for calibrating a stress-testing framework in addition to understanding financial stability risks posed by funds when circumstances are far from usual.

The next section reviews the literature I build on and contribute to. Then I introduce the sector of Czech investment funds, compare it with other investment fund hubs in Europe, and my develop research hypotheses. The fifth section motivates and introduces the empirical strategy. The sixth section summarizes the data. In the seventh section I provide the core of the paper by testing the hypotheses. I follow with a battery of robustness checks that run the gamut from alternative market turmoil conditions, portfolio illiquidity proxies, omitting institutional investor funds or mixed strategy funds, as well as a decomposing investor outflows into expected and unexpected ones. Then I conclude.

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\(^3\) According to the Czech National Bank’s (CNB) statistics, the total assets of the investment fund sector have grown by 541% since 2010:1Q, making it the second-largest financial sector in the Czech financial system, just behind the banking sector (CNB 2021), whose assets grew by 116% between 2010:1Q and 2021:1Q.

\(^4\) See Jank and Wedow (2013) or Keswani and Stolin (2008).
2 Literature review

This paper builds on the literature on run-like behavior among investors in open-ended funds. Coval and Stafford (2007) show that equity funds faced with large investor redemptions need to adjust their portfolios and conduct costly trades, which damage further returns borne by the non-transacting investors and create strategic complementarities as studied in Chen et al. (2010) and Zeng (2017). Chen et al. (2010) find an increased sensitivity of investor outflows to bad performance for equity funds, sensitivity that further increases for portfolios of illiquid assets. Goldstein et al. (2017) explore flow patterns in corporate bond funds. They show that bond funds exhibit a concave flow-to-performance relationship which is quite different from the convex pattern observed for equity funds as shown, for instance, by Chevalier and Ellison (1997).

Closely related to this paper is the work of Chernenko and Sunderam (2016), who investigate changes in cash holdings for U.S. open-ended mutual funds. They show that funds seek to use cash holdings to accommodate inflows and outflows and to mitigate the costs associated with providing investors with claims that are more liquid than the underlying assets. The authors also show that funds that hold a larger fraction of the outstanding amount out of the securities acknowledge the related illiquidity costs and tend to hold more cash. Similarly, Yan (2006) shows that small-cap funds and funds with more volatile fund flows hold more cash.

Leland and Connor (1995) provide a structural framework in which they show that maintaining certain cash balances despite carrying the costs of increased tracking error (estimated in Wermers 2000) is optimal. On the other hand, asset managers can assume that depleting cash holdings could incentivize investors to engage in run-type redemptions (Zeng 2017).

Choi et al. (2020) study fire sales due to investor redemptions and find that corporate bond funds, on average, actively avoid engaging in flow-driven sales of less liquid corporate bonds by depleting liquid buffers first. Nonetheless, they do not rule out the possibility that fire sales occur in some corner of the market where funds are subject to extreme redemptions and liquidity shortfalls. Such liquidity management contrasts with the evidence from equity funds, for instance, Lou (2012), who shows that equity funds are more committed to proportional liquidation of investment holdings in response to investor redemptions.

Jiang et al. (2017) study dynamicity in the liquidity management practices of actively managed U.S. corporate bond funds. They show that the managers of the funds studied tend to increase their relative exposures to illiquid assets by reducing liquid assets first in response to investor redemptions. However, this liquidity management appears to be contingent on market condition as well as funding uncertainty, as shown by the authors. Bond fund managers thus tend to make a trade-off between redemption-induced trading costs that lower near-term fund performance and longer-term vulnerabilities arising from early depletion of liquid buffers.

Shek et al. (2018) and Morris et al. (2017) study flow-driven and discretionary bond sales (sales beyond those necessary to meet redemptions) from portfolios of global bond funds investing in EMs. They find that flow-driven bond
sales reinforce discretionary bond sales, as the funds studied tend to hoard cash. Shrimpf et al. (2021) examine liquidity management in the face of investor redemptions in March 2020 and point to cash hoarding through funds selling illiquid assets ahead of drawing down cash balances. Cleassens and Lewrick (2021) discuss the policy implications of liquidity risks in open-ended bond funds.

Finally, the results presented in this paper may provide inputs into the construction of stress tests of investment funds, where the joint behavior of asset managers and investors is a key accelerator of the initial shock to system-wide stress (Fricke and Fricke 2021; Beranova et al. 2017).

3 Czech investment funds

As a prelude to the formulation of my main research hypotheses, I provide brief background information on Czech investment funds. Czech investment funds (i.e., those domiciled in the Czech Republic) play an important and expanding role in the Czech financial system (Fig. 2 in the Appendix). The significance of the sector passes through the links to multiple sectors (Fig. 3 in the Appendix). The funds’ main investors are domestic households (with an average share of 84% of TNA, or 70% of financial liabilities, as depicted in Fig. 3), but other parts of the financial system also invest in them (such as insurance companies and banks). In general,
funding is predominantly channeled from domestic agents with households accounting for a very significant share (Fig. 3).

Portfolio allocation is guided by the fund’s strategy, with the main bulk of open-ended funds opting for mixed and bond investment strategies, followed by equities (Fig. 2). Funds provide credit intermediation for other sectors, mainly non-financial companies, banks, and the domestic government. They also invest significantly in various foreign assets (49% in terms of financial assets, see Fig. 3) and predominantly hedge against the exchange rate risks.

This paper only covers actively managed open-ended equity funds, bond funds, and mixed funds. I do not study hedge funds, due to limited data coverage and to the closed investor structures and complex and usually highly leveraged investment strategies of such funds. Real estate funds are excluded from the study due to their specific portfolios of highly illiquid assets and to the longer time they take to pay out investor redemptions. I also dropped target date funds because of their different investor flow dynamics (Mao et al. 2022).

The funds studied in this paper are formally retail investment funds under Czech law. Retail investment funds can take the form of UCITS funds (in Czech “standardní fondy”) and retail AIFs (in Czech “speciální fondy”). UCITS funds and retail AIFs in the Czech Republic are very similar in terms of their investment strategies and investors. This contrasts with most other EU countries, where UCITS funds are very different from AIFs. To put it simply, there is no difference in the Czech Republic between the portfolios of retail investment funds regulated according to UCITS and AIFMD. This is due to the merger of UCITS funds and AIFs into one common retail investment fund category whose funds have to obey strict rules based largely on UCITS standards. Non-retail AIFs, on the other hand, usually follow specialized investment strategies and are sought by qualified investors. Under Czech law, these funds are classed in a different category: “qualified investors’ funds”. These funds, even though they may follow bond or equity investment strategies, will not be studied here (Fig. 1).

In terms of size, the Czech investment fund sector is incomparable with the big investment fund centers in Europe, such as Luxembourg, Ireland, and Germany. Even though Czech funds do not have such a large footprint, they may still offer an interesting case study. Interestingly, Czech funds face more volatile net flows from their investors than their counterparts in the above three countries (Fig. 2 in the Appendix). This underlines the importance of liquidity management for the Czech asset managers studied and means that I have a rich dataset of liquidity stress episodes, which is perfect for the topic of my study. Furthermore, the funds studied are largely active in less developed markets, where market liquidity is not high and may evaporate quickly. This adds to the interest in studying these funds, since funds from advanced markets have been increasingly searching for yields in EMs (Kroencke et al. 2015) and it is highly relevant to understand these markets and their players.

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5 Part Seven of Act No. 240/2013 Coll., on Management Companies and Investment Funds.

6 Like real estate funds, qualified investors’ funds can take longer to pay out redemptions.
4 Research hypotheses

I put forth hypotheses that aim to explore liquidity management in open-ended funds and have implications for system-wide vulnerabilities. I frame the study around the two strategies introduced above while emphasizing systemic view given the close implication on system-wide vulnerabilities such as a procyclical manner of selling assets, knock-on effects on other sectors of the economy, and amplification of stress within the financial system. The research questions examined in this study are closely inspired by the work of Jiang et al. (2017), who studied U.S. corporate bond mutual funds and concentrated on distinguishing between fully horizontal and fully vertical cuts, i.e., uniform, and proportional decrease among defined asset classes. I construct similar hypotheses but differ significantly in the approach taken and the general coverage. Firstly, I compare both bond and equity funds domiciled in one of the under-researched EMs, the Czech Republic. Secondly, I follow less strict identification which is built on cash flow identity and thus very natural. This allows me to recognize a more flexible mix of horizontal and vertical cuts. I believe the actual strategy fund that managers tend to engage in lies somewhere in-between rather than involving a purely horizontal or purely vertical cut. Therefore, rather than providing binary results on whether funds follow a vertical or horizontal strategy, I report the propensities with which funds engage in horizontal slicing in various conditions.

Hypothesis 1 On average, bond funds strongly favor the horizontal cut strategy and primarily reduce their liquid buffers in response to cash outflows. In contrast, equity funds tend to use liquid buffers less aggressively.

Bond funds can invest in assets such as loans and corporate bonds. The market liquidity of these assets is lower than that of equities. Additionally, a decrease in market activity due to current regulations and constraints on market makers’ balance sheets has become an important factor of reduced bond market liquidity. Considering the low liquidity of bond funds, the ambiguity about their pricing, and their higher transaction costs, the horizontal cut strategy may thus help preserve funds’ performance.

Fund managers may additionally prefer to avoid costly trading to achieve stable performance that stabilizes investor flows. Goldstein et al. (2017) show a concave flow-to-performance relationship for funds with illiquid assets: their outflows are more sensitive to bad performance than their inflows are to good performance.

To properly distinguish between liquid and illiquid funds, as even bond funds may hold relatively liquid and highly rated bonds, I put forth and test a second hypothesis which goes beyond the bond vs. equity strategy and relates portfolio liquidity to managers’ liquidity practices.

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7 Edwards et al. (2007) find low trade frequency for corporate bonds. This applies particularly to bonds from EMs (Hund and Lesmond 2008).

8 See, for example, Czech and Roberts-Sklar (2019), Bessembinder et al. (2018), and Bao et al. (2018).
Hypothesis 2 The propensity to use liquid buffers increases with the illiquidity of the fund’s portfolio. Funds with illiquid assets engage in considerable liquidity transformation and are more inclined to use the horizontal cut strategy. This illiquidity factor is particularly significant for bond funds.

I expect heterogeneity in liquidity transformation and a propensity to cut portfolios horizontally that is driven by portfolio illiquidity. Funds with highly illiquid portfolios, such as small-capitalization stocks or highly risky corporate bonds, may use their liquid buffers more actively based on the same motives as those given for the first hypothesis. I assume illiquidity is particularly important for bond funds, because bonds are often traded in OTC markets and held to maturity by a large proportion of investors.

Next, I investigate the impact of market conditions on liquidity management in investment funds:

Hypothesis 3 Funds incline to the horizontal cut strategy when market liquidity is low and uncertainty high.

Trading costs become particularly high during episodes of market turmoil, when investor flows may be more sensitive to funds’ liquid holdings (Goldstein et al. 2017). To avoid elevated trading costs, fund managers intensify their propensity to use cash buffers. On the one hand, this mitigates the actual stress on bond prices and may reduce the risk of fire sales. A contradictory driver may be present (Jiang et al. 2017): slumps in liquid buffers can exaggerate the negative externalities for the remaining investors and increase their incentive to make run-type redemptions. Fund managers might be aware of this and hence engage more in vertical cuts. I assume that the horizontal cut-incentivizing channel is stronger and base the third hypothesis on that assumption.

5 Empirical strategy

Czech funds hold significant cash balances (Fig. 4 in the Appendix). Changes in held deposits (ΔDeposits, expressed in currency units as all other variables introduced in Eq. 1) between periods t-1 and t for fund i are caused by investor inflows and outflows and also by inflows from maturing bonds, coupons, and dividends (aggregated in “Inflows from Securities”), by net purchases (or sales) of securities (ΔPortf.)9 during the observed period, and by margin calls for derivative positions and other expenses, such as fees, remunerations, taxes, aggregated in “others”, see Eq. 1.10

9 A positive value of ΔPortf. indicates net sales, and a negative value net purchases.
10 Note that funds can either pay out dividends or reinvest (accumulate) profits. The identity in Eq. 1 is valid for accumulating funds. Nonetheless, it is valid for dividend funds as well, with some discrepancy during months when the fund pays out dividends to its investors (usually once a year according to the prospectuses of large Czech dividend paying funds).
To connect the identity of cash balances to the horizontal and vertical cut strategies, one can see that only bank transfers can settle redemptions—the propensity to reduce cash balances in response to investor outflows is strictly speaking minus one, a pure horizontal cut. However, funds may react to the depletion of cash buffers by rebuilding them via sales of other assets, resulting in a vertical cut of the portfolio. Formally, I can express net purchases of securities as follows in Eq. 2.

\[
\Delta \text{Deposits}_{i,t} = +\text{Inv.Inflows}_{i,t} - \text{Inv.Outflows}_{i,t} + \text{Inflows from Sec.}_{i,t} + \Delta \text{Portf.}_{i,t} + \text{Others}_{i,t}
\]

(1)

Naturally, funds purchase securities with cash from investors or other sources such as inflows from maturing bonds and dividends. The manager has propensities \( \beta_1 \) and \( \beta_3 \) to pass these inflows into new purchases. Similarly, she may prefer to compensate the decrease in cash buffers caused by redemptions by selling assets from the portfolio—the propensity to cut the portfolio vertically (\( \beta_2 \)). For example, \( \beta_2 = 0.5 \) would mean that for each 1 currency unit redemption request the portfolio manager sells 0.5 currency units of held securities (recall the footnote n. 9). I also assume sales or purchases to be dependent to some extent on the other flows (\( \beta_4 \)). For instance, the large exchange rate volatility observed during the pandemic might have led to significant margin calls, and investment funds might have needed to sell some of their assets in response.

Of course, investment decisions are more complex as I indicate by the error term \( \epsilon_{i,t} \). Other factors of various complexity and measurability influence investment decisions and the preference for vertical cuts at any given moment. They include, for instance, the investment strategy, expectations, the general level of risk and uncertainty in the markets, and contemporaneous trading costs. These factors provide the core of my research hypotheses and the ground for control variables described later at the end of this section.

Substituting Eq. 2 into Eq. 1 results in Eq. 3. Two important measures result from the substitution. The parameter \( 1 + \beta_1 = \gamma_1 \) shows the fund’s propensity to build its cash buffers: to perform liquidity transformation. The parameter \( \beta_2 - 1 = \gamma_2 \) reflects the fund’s propensity to accommodate investor redemptions by depleting its cash buffers, i.e., the horizontal cut preference. The smaller is \( \gamma_2 \), the stronger is the propensity to meet redemptions with cash buffers and the lower is the propensity to sell less liquid assets.

\[
\Delta \text{Deposits}_{i,t} = \alpha + (1 + \beta_1) \text{Inv.Inflows}_{i,t} + (\beta_2 - 1) \text{Inv.Outflows}_{i,t} + (1 + \beta_3) \text{Inflows from Sec.}_{i,t} + (1 + \beta_4) \text{Others}_{i,t} + \epsilon_{i,t}
\]

(3)

I would now like to emphasize the benefit of recognizing flows other than flows from investors. As far as I know, this is a novel feature that has not been taken into
account yet. I believe it is important to control for flows other than net flows from investors when studying liquidity management practices because funds might use various inflows to meet investor redemptions. However, some of these inflows are hardly under the fund’s control and cannot be relied upon. Funds can indeed hardly plan inflows from dividends, coupons, or bond maturities to meet investor redemptions. I effectively isolate the impact of other inflows on fund’s liquidity management by recognizing them in the models.

Secondly, and closely related to the first aspect, the reconstruction of flows is equally crucial for distinguishing between a reduction in less-liquid assets due to maturities—included in inflows from securities—and one due to potentially destabilizing and costly sales that are included in \( \Delta \text{Portf} \). I thus capture only net sales adjusted for maturities as evidence for vertical slicing. Such a distinction is in line with the focus on the risks to financial stability. When measuring the risks to financial stability, one is rather concerned more with the destabilizing aspects of the vertical slicing and the related costly sales of illiquid assets potentially leading to fire sales and contagion.

Coming back to liquidity management practices, it can naturally be presumed that deposits in banks are not the only liquid assets held by funds to build their resilience to liquidity risk and manage their cash flows. Therefore, I will split assets in portfolios into two groups. On the one side, I have money (current deposits) together with its surrogates, consisting of very liquid assets such as short-term repos, money market fund shares, and highly rated and easy-to-pledge short-term government bills. On the other side, I have less-liquid assets with presumably higher trading costs: primarily corporate bonds and equities.

The addition of money surrogates to current deposits does not disrupt the identification of vertical or horizontal cut outlined above, under some mild assumptions presented shortly, but provides a crucial and more precise distinction between horizontal and vertical cuts. Without that, reductions in money surrogates would be incorrectly identified as evidence of vertical cuts.

Because of the available transformation of money surrogates into bank deposits (i.e., the means of final settlement for investor redemptions) on demand and at par (Pozsar 2014), be it through repos or a very stable value of money market fund share, I claim redemptions can be satisfied perfectly with these assets as well. Any purchase or sale of money surrogates hence only changes the form of money, leaving the parity to meet redemptions intact. Formally, I can write:

\[
\Delta \text{Deposits}_{i,t} + \Delta \text{NearMoney}_{i,t} = \text{Inv.Inflows}_{i,t} - \text{Inv.Outflows}_{i,t} + \text{Inflows from Sec}_{i,t} + \Delta \text{Portf}_{\text{illiquid},i,t} + \text{Others}_{i,t}
\]

where \( \Delta \text{NearMoney} \) consists of net sales (−) or net purchases (+) of near-money assets. Hence, it does not matter if the fund purchases money surrogates because they are readily available to meet redemptions. \( \Delta \text{Portf}_{\text{illiquid}} \) tracks net purchases (or

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11 Note that I do not study or discuss money market funds whose managers invest in short-term money market instruments and whose maturity profile may target the expected patterns in investor flows.
sales) of less liquid assets, i.e., securities not contained in the defined money-like assets, similarly as shown by Eq. 2. In the following sections, I use the term liquid buffers for the sum of deposits and near money assets on the left-hand side, and $\Delta Portf$. rather than $\Delta Portf_{\text{illiquid}}$.

Apart from the key sources of changes in liquid buffers presented above, some fund-specific control variables are also considered relevant to the choice of liquidity management practices. I include fund age, as measured by the time the fund has survived to control for the fund’s longevity and managers’ ability (Ferreira et al. 2012; Pástor et al. 2015). Similarly, I control for the size of the investment fund with its lagged total assets. For example, larger and older funds could be paired with more skilled managers if such managers perform better and attract more flows, or if larger profitable funds can afford to hire better managers. To capture the dynamicity in investor flows I also add the classical controls regularly used in the cited studies: lagged raw returns and the total expense ratio.

The share of retail investors is also controlled for. Institutional investor-oriented funds may display different investor flow dynamics. “Smart money” has been shown to internalize the negative externalities generated by outflows and thus be less incentivized by the first-mover advantage (Goldstein et al. 2017). On the other hand, institutional investors are capable of better monitoring of a fund’s performance and thus react more strongly to previous returns (Schmidt et al. 2016).

Finally, managers with large built-up cash ratios may on average be more inclined to follow the horizontal strategy since they have built their liquid buffers with horizontal strategy in mind. Similarly, investor flow volatility may be endogenously lower on the grounds that investors may be less worried when their funds have significant liquid buffers (Chen et al. 2010). To cater for these endogeneity concerns, the fund-specific control variables are expanded by funds’ lagged liquid buffers (% of TNA). Furthermore, one of the robustness tests employs unexpected investor redemptions obtained as residuals from fund-wise regressions of investor outflows on lagged investor outflows and lagged fund liquid buffers. The test confirms the results and is presented later on. Omitted-variable bias is of less concern, as I consider the multiple right-hand side controls introduced above as well as fund-fixed effects and time-fixed effects.

6 Data and summary statistics

I use monthly survivorship bias-free data on Czech open-ended funds observed from 2011 to April 2021. I subdivide the universe of Czech open-ended funds into bond funds, equity funds, and mixed funds, which invest in both stocks and bonds. Mixed funds are split according to the holdings in their portfolios. I label mixed funds with less than 40% of their portfolios allocated in bonds as equity funds, and the rest as bond funds. I provide a robustness check that the results are not driven by mixed funds later on. This selection process gives me 78 unique bond funds and 117 equity funds. I drop dividend-paying funds for the forthcoming analyses, although the results are almost the same when the funds are included. This is not surprising given the low frequency of dividend payments (mostly once a year).
I then reconstruct the flows outlined in the previous section to study liquidity transformation and liquidity management strategies. Firstly, the reconstruction takes advantage of the available actual investor gross flows reported directly by funds. The gross flows thus capture investor in- and outflows separately at the realized prices and are thus more insightful than net flows.

Secondly, I use monthly reports collected by the CNB for funds’ bank deposits and repos, as well as detailed security-by-security positions. I observe the nominal value (in the original currency of denomination) and the market value held at the end of the month by the given fund at the security level. Additional information about the securities is obtained by combining the ECB’s CSDB database and Refinitiv. I calculate payments from securities held for each fund throughout the observed period. These include coupons, maturities, and dividends from equities and funds if held on the ex-date. Of course, there may be some discrepancies due to day conventions, taxes, and fees, or due to the monthly frequency at which I observe the portfolios. For example, a fund could have bought a coupon bond in the month of its coupon payment, but without the right to the coupon.

To calculate purchases and sales of securities, I track changes in the reported nominal values held adjusted for possible splits, i.e., changes in portfolios caused by active trading only, and uncontaminated by changes in the market values or exchange rate movement. If a fund changes holding of a splits-adjusted nominal value on a particular ISIN, i.e., a purchase if increased or a sale if decreased, I calculate the impact on the fund’s cash flows. Only monthly snapshots of positions are available and there is no information on when exactly the fund executed the trade and at what price. Therefore, I use the price known at the beginning of the month (see Shek et al. 2018, for a similar solution). This introduces some additional discrepancies into the cash flow reconstruction, since the price or exchange rate could be different on the actual transaction date.

The last item in Eq. (1)—“others”— ought to be easy to calculate, because it is the last missing item that equals the left-hand side with the flows reconstructed above. Without a doubt, “others” may contain discrepancies accumulated during the reconstruction of the flows above. Nonetheless, the main sources should be margin calls in derivatives and errors caused by differences in calculated and realized flows from net sales or net purchases in the portfolios. Either way, the sign indicates the shock to the fund’s cash flows. If the sign is positive, the shock is positive: the fund obtained a larger amount from sales of securities, paid less in purchases, or received an inflow from a margin account. If the sign is negative, the shock is negative because of sales realized at a lower price or purchases realized at a higher price, or due to an outflow to a margin account.

Having reconstructed the flows, I calculate a measure of portfolio liquidity for each fund. Because trading data for bonds from emerging markets are unavailable, I build a measure inspired by the LCR regulation (BCBS 2013). I assign haircuts to each security according to its credit rating and using the security’s LCR status (level) obtained from Refinitiv Eikon. Deposits and deposit-like assets such as money market fund shares, together with highly rated government bonds, obtain a 0% haircut. On the other side of the rating spectrum, bonds from speculative credit
grades and unrated bonds obtain the highest 50% haircut. I calculate the fund-level illiquidity measure as the value-weighted average of the haircuts.

An alternative illiquidity measure for bonds is constructed as the value held relative to the total outstanding amount out at the end of the month. I assume that long positions in bonds where the fund is effectively the only investor are particularly illiquid and it may be very costly to liquidate these positions promptly. I calculate a second bond fund level illiquidity measure as the value-weighted average of the values held relative to their amounts out.

For equity funds, I approximate portfolio liquidity using two distinct aggregated measures built on market capitalizations and volumes traded. Specifically, for each period I assign each ISIN held to the market capitalization deciles (from the highest to the lowest). I denote the deciles with numbers from 1 to 10, meaning that the top 10% largest market caps obtain 1 and so on. Finally, I take the value-weighted average of the assigned decile values (1–10) to get a market cap-based illiquidity measure for stock portfolio illiquidity. I repeat the same decile-based approach for the second portfolio illiquidity measure based on volumes traded obtained from the ECB’s CSDB database combined with Refinitiv where needed.

Summary statistics for the individual flows (here expressed in % of TNA for comparability) as well as other explanatory variables are given in Table 1. Regarding the flows, the most volatile items are net purchases and net sales (Δ Portf.) and investor flows. Inflows from securities with their lowest volatility may still occasionally represent an important source of cash as can be seen (p90 almost 3% of TNA). Figure 5 in the Appendix shows the evolution of flows during 2020, with significant spikes during the COVID-19 crisis. The relevance of inflows from securities for bond funds can be also observed there. Note that inflows are not that important for equity funds, which is not surprising.

7 Results

This section constitutes the core of the paper and presents the main findings. I start by running a baseline panel regression relating monthly changes in liquid buffers as motivated above:

\[
\Delta \text{Liq.Buffer}_{i,t} = \alpha_i + \tau_t + \gamma_1 \text{Inv.Inflows}_{i,t} + \gamma_2 \text{Inv.Outflows}_{i,t} + \gamma_3 \text{Inflows from Sec.}_{i,t} + \gamma_4 \text{Others}_{i,t} + \beta \text{CONTROLS}_{i,t-1} + e_{i,t}
\]

(5)

where \(\Delta \text{Liq.Buffer}_{i,t}\) is the change in holdings of liquid buffers which consists of bank deposits and money surrogates for fund \(i\) between months \(t-1\) and \(t\). Liquid buffers and all the other flows introduced above are still quoted in currency units. The control variables are lagged and include fund characteristics: the natural log of total assets, share of retail investors (%), the total expense ratios (%), the funds’ returns (%), and the share of liquid buffers (% of total assets). I omit the \(\beta\)s for the control variables to save space when reporting results. I also use time-fixed effects (\(\tau_t\)) to absorb the influence on the fund’s investment decisions due to changes in...
economic conditions. All the results are further based on panel regressions with fund-fixed effects ($\alpha_i$) and double-clustering robust standard errors following Petersen (2009). I estimate the coefficient separately for the two subsets: bond funds and equity funds. Moreover, the parameters should not be significantly inflated by multicollinearity (see Table 7 in the Appendix for variance inflation factors).12

Table 2 column 1 shows that bond funds’ liquidation strategy resembles horizontal cutting. In terms of magnitude, the economically and statistically significant parameter $\gamma_2 = -0.68$ shows that CZK 1 in redemptions is associated with a contemporaneous decline in liquid buffers of CZK 0.68. However, this also means that on average, fund managers tended to engage in a 0.32 net reduction in less liquid assets. The size of liquidity transformation is also significant ($\gamma_1 = 0.37$), suggesting that from CZK 1 inflow, CZK 0.37 is retained in liquid buffers on average.

The baseline results for bond funds contrast with the results for equity funds (column 2). For them, I report curtailed use of liquid buffers to accommodate flows ($\gamma_2 = -0.23$). Liquid transformation is also lower for equity funds ($\gamma_1 = 0.22$). In summary, the baseline results show that funds performing sizable liquidity

12 The largest correlation (0.47) is between inflows and outflows for equity funds which is in line with findings of Jank and Wedow (2013).
13 Since all the models are estimated on flows denominated in CZK, I use CZK as the reference currency. However, the parameters would naturally be the same regardless of the denominating currency if all the flows were converted to EUR for example.
transformation contemporaneously deplete their liquid buffers to accommodate flows more intensively.

There is also a difference in managing inflows from securities. Equity funds on average retain a significant part of the contemporaneous inflows from securities ($\gamma_3 = 0.93$). On the other hand, bond funds tend to retain 53% on average in their liquid buffers according to the estimates ($\gamma_3 = 0.53$).

To test the second hypothesis, I add interaction terms measuring lagged fund portfolio illiquidity. The linear model is specified as follows:

$$
\Delta Liq.\text{Buffer}_i,t = \alpha + \tau_t + \gamma_1 \text{Inv. Inflows}_i,t + \gamma_2 \text{Inv. Inflows}_i,t \times ILLIQ_{i,t-1} + \gamma_3 \text{Inv. Outflows}_i,t \\
+ \gamma_4 \text{Inv. Outflows}_i,t \times ILLIQ_{i,t-1} + \gamma_5 \text{Inflows from Sec.}_i,t + \gamma_6 \text{Inflows from Sec.}_i,t \times ILLIQ_{i,t-1} \\
+ \gamma_7 \text{Others}_i,t + \gamma_8 \text{Others}_i,t \times ILLIQ_{i,t-1} + \beta \text{CONTROLS}_i,t-1 + e_{i,t}
$$

(6)

where $ILLIQ_{i,t-1}$ denotes the one-period-lagged illiquidity dummy variable for the $i$th fund’s portfolio. The dummy variable takes the value 1 if the fund’s calculated illiquidity variable is above the 75th quantile. I use various illiquidity measures introduced in the previous section for robustness. For bond funds, I interact with the average haircuts (Table 3, column 1) and the average shares in amount out (column 2). For equity funds, I interact with the market cap-based measure (column 3) and the volumes traded-based measure (column 4).

From the first column, funds with illiquid bond holdings increase the accommodation of investor outflows with liquid buffers (by additional CZK $-0.43$ CZK on CZK 1 of investor outflows). The second column confirms the results for bond funds using the alternative measure for portfolio illiquidity (column 2, Table 3).

The influence of portfolio liquidity in liquidity management practices does not hold for the equity funds in the sample. Indeed, funds with illiquid equity holdings do not elevate their reliance on liquid buffers when meeting investor redemptions.
The parameters are economically and statistically insignificant for both fund illiquidity proxies employed to isolate illiquid equity funds. The results for equity funds also show that, on average, equity funds increase their accommodation to shocks (measured by the “other” item) by reducing their cash buffers rather than by selling holdings when the illiquidity of holdings is high. This shall be read with caution though, since the factors which enter the variable cannot be accurately pinned down.

Hypothesis 3 assumes that funds intensify their propensity to deplete liquid buffers during periods of turmoil. I identify periods of market stress using the VIX index, which approximates stock market volatility. Bao et al. (2011) find that an increase in the VIX index negatively impacts the liquidity of bond markets as well. Specifically, I use a VIX dummy which is equal to 1 if the observed VIX is above the 75% in-sample quantile calculated for the whole observed period. I interact with the dummy as in Eq. 7. Estimates of the parameters are presented separately for bond and equity funds in Table 4.
Clearly, in the observed period bond funds tended to avoid sales from portfolios during episodes of elevated market stress, as is visible from an abrupt increase in the propensity with which investor outflows are met with liquid buffers. On average, bond funds met CZK 1 outflow of investors with CZK 0.91 depletion in liquid buffers (−0.43 − 0.48).

I find statistical evidence of an increased propensity to retain inflows from securities, such as matured bonds, for bond funds during periods of market turmoil (γ6 = 0.33).

Table 4 shows the impact of an inflated VIX on liquidity management in equity funds. I uncover a dash-to-cash incentive in response to investor outflows during stress periods. Equity funds meet a CZK 1 investor redemption with a CZK 0.27 reduction in liquid buffers during tranquil periods, so CZK 0.73 is met with sales of equities. However, as soon as market liquidity shrinks and volatility rises, a CZK 1 investor redemption is met with a CZK 0.26 increase in their liquid buffers.

\[
\Delta \text{Liq.Buffer}_{it} = \alpha_i + \tau_t + \gamma_1 \text{Inv.Inflows}_{it} + \gamma_2 \text{Inv.Inflows from Sec}_{it} + \gamma_3 \text{Inv.Inflows from Sec}_{it} \times \text{VIX}_t + \gamma_4 \text{Inv.Outflows}_{it} + \gamma_5 \text{Inv.Outflows from Sec}_{it} + \gamma_6 \text{Inv.Outflows from Sec}_{it} \times \text{VIX}_t + \gamma_7 \text{Others}_{it} + \gamma_8 \text{Others}_{it} + \beta \text{CONTROLS}_{it-1} + e_{it}
\]

(7)

The table reports the results of regressions as specified in Eq. 7, i.e., including time-fixed effects and individual fund-fixed effects. To save space, I do not report estimates for fund control variables. Values shown in parentheses are double-clustering robust standard errors. *** 1% significance; ** 5% significance; * 10% significance.
\(-0.27 + 0.53\). The dash for cash could feed through fire sales in equity markets (see, for example., Coval and Stafford 2007).

### 8 Robustness tests

Besides the alternative measures of portfolio illiquidity already included in the main results, I provide some additional robustness checks. Firstly, I want to examine whether the results are robust to both expected and unexpected investor outflows. All the estimated linear models included lagged liquid buffers to control for the fact that funds that hold large buffers of liquid assets can rely more on them and may thus be more willing to draw on them first. Additionally, those funds may expect lower redemptions and feel more confident to deplete liquid buffers first, since investors know that the fund is stacked with cash and are therefore not that concerned about the risks arising from increasing exposure to less liquid assets. What I want to examine now is the reaction of asset managers to unexpected investor outflows. It might be the case that the horizontal slicing is preferred only to meet expected investor outflows, and unexpected outflows are met through the vertical slicing.

Therefore, I estimate the fund’s expected investor outflows by regressing its current investor outflows on its lagged investor outflows (lagged up to 3 periods) and its lagged liquid buffers (with the same lags). I then assign the residuals obtained to unexpected investor outflows.14 I present results that include the decomposed outflows in Table 8 in the Appendix.

Starting with the baseline results, I show that bond funds are still vigorously following the horizontal slicing than equity funds. This applies even when the investor outflows are unexpected. The next columns report when the illiquidity of portfolios are accounted for the use of the proxies constructed above. One can see a similar difference between the way bond funds met expected and unexpected redemptions on average conditional on the portfolio being illiquid. Consistently, the results with the VIX turmoil dummy show increased reliance on liquid buffers when the market is under stress and that stays significant even for the unexpected redemptions. Note that I still find the dash to cash behavior for equity funds.

I then test the extent to which the results change if I redefine the VIX dummy variable. Let the new dummy variable be equal to one if the monthly VIX is above its 2Y rolling median. This presumably over-sensitive measure, which sends signals even for periods of relatively low stress, confirms the main conclusions for bond funds. For equity funds, I no longer observe dash-for-cash behavior. Intuitively, dash to cash occurs primarily during major crises as the previous results suggest.

It has been motivated why the VIX index should capture market turmoil for bond funds. To make sure the results are robust even to different stress measures, I classify

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14 Such modelling of unexpected investor flows is relatively common. See, for instance, Fong et al. (2018).
I then tested whether the results are robust and not influenced by the presence of institutional funds in the sample. Institutional funds may have different flow dynamics, and, realizing this, asset managers may engage in a different strategy to meet their redemptions. I follow Goldstein et al. (2017) in identifying institutional funds as those with a share of retail investors lower than 25%. The results after leaving institutional funds out from the regressions are presented in Table 9 in the Appendix and lead to the same conclusions.

---

15 Goldstein et al. (2017) uses a 20% threshold, so I am a little more conservative.
Lastly, note that the results should be interpreted as “average” reactions and may be influenced by steady-state, business-as-usual management practices. However, behavior during stress periods, when funds face the dilemma of choosing the best strategy to meet redemptions, might be of primary interest to policymakers and regulators. I have already estimated the effect of market turmoil as measured by the VIX on the parameters. However, these periods are not necessarily situations in which funds face the above dilemma. For instance, during March 2020, when I observe the highest VIX in the entire observed period, over 50% of funds registered positive net investor inflows.

I make use of the unique insight offered by the data and examine specific periods only. Specifically, I focus on periods when a fund faced the need to reduce its balance sheet and had to choose which strategy to follow the most. I study episodes when a fund faced a net cash need, i.e., months during which the fund found itself in a liquidity need caused by a net cash outflow net of inflows from securities or residual “other” flows. Using an indicator function, I can formalize the condition as follows:

\[ \text{Liquidity need}_{i,t} = I[\text{Inv.Inflows}_{i,t} + \text{Inv.Outflows}_{i,t} + \text{Inflows from Sec}_{i,t} + \text{Others}_{i,t} < 0] \]

(8)

I run the baseline panel regression again on the subset of funds with a liquidity need equal to one. This reduces the sample dramatically, but the parameters obtained now correspond to the average stress-implied strategy. The results are given in columns 1 and 2 of Table 6. Importantly, I still observe a significant preference for the horizontal cut strategy for bond funds: a CZK 1 investor outflow during a liquidity need led to an average decrease in the liquid buffers of CZK 0.77. I report results for equity funds, too. These do not offer statistically significant evidence of a reduction in liquid buffers in response to investor redemption when equity funds faced a general liquidity need. This means that funds meet redemptions by selling securities from their portfolios. The results should be treated with caution, since I observe increased variance inflation factors in the subset for equity funds (maximum value of 3.24). This should not be an issue for bond funds (no variance inflation factor is greater than 1.56).

I provide an alternative liquidity need condition which is simply the subset for periods during which investor net flows were negative, i.e., excluding information about other sources of possible inflows or outflows funds may face. The results are given in columns 3 and 4 of Table 6. Firstly, note the different number of observations when negative investor flows are used as the indicator of a liquidity need. This emphasizes the importance of fully treating cash flows in investment funds and shows that other flows can change the liquidity position obtained from net investor flows. The new observations come from episodes when funds had negative investor flows but received larger inflows from, for example, a maturing bond. Nonetheless, the results remain consistent with the previous ones for bond funds, as a comparison between columns in Table 6 shows. I still observe inflated variance inflation factors for equity funds in the subset, but reading the results with caution seems to confirm a preference for meeting investor outflows by selling securities from portfolios.

Finally, I provide baseline results when one omits funds with mixed strategy investment policy. Since the results are very similar, see Table 10 in the Appendix, I show that the results are not driven by the mixed funds.
9 Conclusion

Based on a unique reconstruction of cash flows in Czech open-ended equity and bond funds from 2011 to April 2021 I investigated the dynamicity of their liquidity management. I studied the propensity to meet outflows with a reduction in liquid buffers as well as the size of liquidity transformation, both mentioned in the literature as substantial sources of risk to financial stability.

I showed that bond funds on average perform sizable liquidity transformation and contemporaneously deplete liquid buffers to accommodate investor outflows more intensively than equity funds. Taking a closer look at portfolio illiquidity, which I measure using various approaches, I point to even more intense liquidity transformation and a propensity to cut portfolios horizontally for bond funds. The depletion of liquid buffers is furthermore enhanced during market turmoil for bond funds. Serious market stress was shown to lead equity funds to engage in dash-for-cash behavior on the other hand.

I want to emphasize the prevalence of the horizontal cut strategy, which has been confirmed for bond funds and which is furthermore elevated during stress conditions. Because it incentivizes run-type redemptions, such a liquidity management practice may be a source of risks to financial stability. The reduction in liquid buffers could be suddenly reassessed by market participants and become a self-imposing factor for larger outflows given the first-mover advantage. This could be coupled with low illiquidity of bond holdings in particular, since I find a growing reluctance to engage in proportionate cuts when illiquidity in portfolios is considered. However, from the opposite point of view, Czech bond funds seem to act countercyclically, since they prefer drawing on liquid buffers first to selling

| Table 6 | Results for the liquidity stress episodes |
|---------|------------------------------------------|
| (Liquidity need, bond funds) | (Liquidity need, equity funds) | (Neg. investor flows, bond funds) | (Neg. investor flows, equity funds) |
| Inv. Inflows (t) | 0.83*** | 1.07*** | 0.6*** | 0.45 |
| [0.11] | [0.3] | [0.19] | [0.36] |
| Inv. Outflows (t) | −0.77*** | −0.18 | −0.75*** | −0.22 |
| [0.09] | [0.12] | [0.09] | [0.16] |
| Inflows from Sec. (t) | 0.09 | 1.18** | 0.56*** | 0.71*** |
| [0.35] | [0.44] | [0.03] | [0.04] |
| Others (t) | 0.48 | 1.02*** | 0.63*** | 0.66*** |
| [0.07] | [0.19] | [0.18] | [0.2] |
| Fund controls | Yes | Yes | Yes | Yes |
| Adjusted R-squared | 0.48 | 0.05 | 0.4 | 0.05 |
| Number of observations | 1271 | 1616 | 2332 | 2085 |

The table reports the estimation results of the regression specified in Eq. 5, i.e., including time-fixed effects and individual fund-fixed effects. Columns 1 and 2 are estimated for the subset of bond and equity funds during a liquidity need (Eq. 8), and columns 3 and 4 are estimated for the subset of bond and equity funds during negative investor net flows. To save space, I do not report estimates for fund control variables. Values shown in parentheses are double-clustering robust standard errors. *** 1% significance; ** 5% significance; * 10% significance
illiquid holdings. This can be read as beneficial from the financial stability point of view to the moment liquid buffers are sufficient enough and the strategic complementarities are limited. However, if their liquid buffers became depleted and the building up of redemption requests continued, risks to fire sales could dramatically increase.

Therefore, I believe there is a need to conduct further research which would investigate whether funds prefer this behavior because of their smart financial-stability-friendly countercyclical investment behavior or whether this is caused purely by an extreme illiquidity of their less liquid holdings.

What are the options and can we learn a lesson so far? Funds can currently activate liquidity management tools which according to the prospectus of reviewed funds predominantly mention the option for suspending redemptions, since this is the only legal option (see section 136 of Act No. 240/2013 Coll., on Management Companies and Investment Funds, section 136). However, a sudden suspension could trigger a panic among investors and spread contagion in the system. Furthermore, just the prospect of such suspension could set off self-reinforcing preemptive redemptions as has been shown for money market funds (FSB 2020). Similarly, fund managers could refrain from suspending redemptions in order to avoid reputational damage (IOSCO 2018; ESRB 2021; Grill et al. 2021). Therefore, it seems preferable to actively pass trading costs on transacting investors via swing pricing or anti-dilution levies, rather than suddenly suspending redemptions. This would compel fund managers to reflect bond portfolio illiquidity in each redemption request regardless of the liquidity management practice. Nonetheless, the effectiveness of active liquidity management tools hinges on a correct assessment of liquidation costs, which can become very difficult when liquidity has evaporated.

Appendix

See Figs. 2, 3, 4 and 5 and Tables 7, 8, 9 and 10.

Fig. 2 Total Assets of Czech Investment Funds (% of GDP). Source: CNB

16 See also Table 4.3.A in ESRB (2019).
Fig. 3  Position of investment funds in the Czech financial system. Note Data as of 2020:2Q. For clarity, the chart excludes: (1) links of less than CZK 20 billion, (2) links that are not related to IFs. The enclosed numbers indicate the percentage share in the financial assets (orange) or liabilities (blue) of the Czech investment fund sector. The size of the node illustrates the size of the given sector. Captive financial institutions are included in the NFCs sector. NFCs non-financial corporations, IFs investment funds, PFs pension funds, OFIs other financial intermediaries, CNB Czech National Bank. Source: Kučera and Szabo (2020), CNB Financial Account Statistics

Fig. 4 Liquid Buffers for the Subset of Czech Bond Funds (% of TNA). Note Liquid buffers consist of bank deposits and money surrogates (short term repos, MMF shares, and government bills). Source: CNB
**Fig. 5** Box plots for reconstructed cash flows in 2020. *Source:* CNB and author’s calculations

**Table 7** Variance inflation factors

|                           | (Bond funds) | (Equity funds) |
|---------------------------|--------------|----------------|
| Inv. Inflows (t)          | 1.72         | 2.16           |
| Inv. Outflows (t)         | 1.49         | 1.81           |
| Inflows from Sec. (t)     | 1.59         | 1.48           |
| Others (t)                | 1.33         | 1.02           |

Variance inflation factors estimated for the baseline model in Eq. 5. A rule of thumb is that if VIF is higher than 5 than the severity of multicollinearity is considerable.
Table 8 Robustness results with unexpected investor outflows

| Bond funds                          |          |          |          |          |          |          |          |          |          |
|------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| (Baseline)                         | (Illiquidity dummy 1 lagged) | (Illiquidity dummy 2 lagged) | (VIX dummy) |            | (Baseline) | (Illiquidity dummy 1 lagged) | (Illiquidity dummy 2 lagged) | (VIX dummy) |          |
| Inv. Inflows (t)                   | 0.36***  | 0.31***  | 0.27***  | 0.32***  | 0.22***  | 0.3***   | 0.32***  | 0.26***  |          |
| [0.07]                             | [0.08]   | [0.07]   | [0.06]   | [0.05]   | [0.08]   | [0.06]   | [0.06]   | [0.03]   |          |
| Exp. Inv. Outflows (t)             | −0.8***  | −0.24    | −0.43*** | −0.4***  | −0.35*** | −0.49*** | −0.48*** | −0.39*** |          |
| [0.14]                             | [0.15]   | [0.11]   | [0.12]   | [0.06]   | [0.13]   | [0.82]   | [0.05]   |          |          |
| Unexp. Inv. Outflows (t)           | −0.6***  | −0.41*** | −0.38*** | −0.43*** | −0.13*** | −0.13*** | −0.19*** | −0.17*** |          |
| [0.12]                             | [0.09]   | [0.07]   | [0.09]   | [0.06]   | [0.02]   | [0.04]   |          |          |          |
| Inflows from Sec. (t)              | 0.55***  | 0.56***  | 0.64***  | 0.41***  | 0.97***  | 0.78***  | 1.14***  | 0.98***  |          |
| [0.04]                             | [0.05]   | [0.07]   | [0.07]   | [0.09]   | [0.26]   | [0.11]   | [0.07]   |          |          |
| Others (t)                         | 0.48***  | 0.6***   | 0.27***  | 0.6***   | 0.69***  | 0.51***  | 0.58***  | 0.81***  |          |
| [0.12]                             | [0.15]   | [0.05]   | [−0.11]  | [0.13]   | [0.11]   | [0.11]   | [0.12]   |          |          |
| Inv. Inflows (t) × DUMMY           | −        | 0.09     | 0.18     | 0.08     | −        | −0.11    | −0.06    | −0.08    |          |
| [0.11]                             | [0.12]   | [0.07]   |          | [0.13]   | [0.11]   | [0.16]   | [0.23]   |          |          |
| Exp. Inv. Outflows (t) × DUMMY     | −        | −0.73*** | −0.38*   | −0.62*** | −        | 0.2*     | 0.25     | 0.42**   |          |
| [0.17]                             | [0.22]   | [0.12]   |          | [0.12]   | [0.17]   | [0.16]   |          |          |          |
| Unexp. Inv. Outflows (t) × DUMMY   | −        | −0.31*   | −0.22*   | −0.43*** | −        | −0.14    | −0.08    | 0.52     |          |
| [0.17]                             | [0.13]   | [0.07]   |          | [0.21]   | [0.34]   | [0.34]   |          |          |          |
| Inflows from Sec. (t) × DUMMY      | −        | 0.15     | −0.03    | 0.32***  | −        | 0.19     | −0.67*** | 1.49     |          |
| [0.13]                             | [0.08]   | [0.08]   |          | [0.29]   | [0.14]   | [1.52]   |          |          |          |
| Others (t) × DUMMY                 | −        | −0.35**  | 0.17     | −0.4**   | −        | 0.44***  | 0.42*    | −0.35*** |          |
| [0.17]                             | [0.16]   | [0.16]   |          | [0.13]   | [0.23]   | [0.05]   |          |          |          |
| Fund controls                      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      |          |
| Adjusted R-squared                 | 0.35     | 0.39     | 0.35     | 0.39     | 0.19     | 0.21     | 0.21     | 0.21     |          |
| Number of observations             | 5 025    | 4 971    | 4 971    | 5 025    | 6 537    | 6 501    | 6 501    | 6 537    |          |

The table reports the estimation results of a regression including time-fixed effects and individual fund-fixed effects. For the dummy variables, columns 2 and 3 are estimated for bond funds using the average haircut and average share in amount out, respectively. For equity funds, the illiquidity dummy variables go as follows: average market cap decile and volumes traded decile. To save space, I do not report estimates for fund control variables. Values shown in parentheses are double clustering robust standard errors by funds. *** 1% significance; ** 5% significance; * 10% significance.
Table 9 Robustness results without institutional funds

|                      | Bond funds                                                                 | Equity funds                                                                 |
|----------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
|                      | (Baseline) | (Illiquidity dummy 1 lagged) | (Illiquidity dummy 2 lagged) | (VIX dummy) | (Baseline) | (Illiquidity dummy 1 lagged) | (Illiquidity dummy 2 lagged) | (VIX dummy) |
| Inv. Inflows (t)     | 0.36***    | 0.29***                         | 0.27***                        | 0.28***                         | 0.24***    | 0.36**                         | 0.4***                        | 0.27***     |
|                      | [0.08]     | [0.09]                          | [0.07]                         | [0.06]                          | [0.07]     | [0.15]                         | [0.12]                        | [0.05]      |
| Inv. Outflows (t)    | -0.67****  | -0.37***                        | -0.42***                       | -0.4***                         | -0.18***   | -0.1                         | -0.16***                   | -0.24***     |
|                      | [0.15]     | [0.11]                          | [0.09]                         | [0.1]                           | [0.06]     | [0.07]                         | [0.05]                        | [0.05]      |
| Inflows from Sec. (t)| 0.53***    | 0.55***                         | 0.61***                        | 0.4***                         | 0.97***    | 0.55                            | 1.14***                   | 1***        |
|                      | [0.05]     | [0.06]                          | [0.08]                         | [0.07]                          | [0.1]     | [0.43]                         | [0.11]                        | [0.07]      |
| Others (t)           | 0.40***    | 0.50***                         | 0.26***                      | 0.6***                         | 0.7***    | 0.49***                       | 0.58***                  | 0.81***     |
|                      | [0.14]     | [0.17]                          | [0.05]                         | [0.11]                          | [0.15]     | [0.11]                         | [0.17]                        | [0.13]      |
| Inv. Inflows (t) × DUMMY | -         | 0.14                           | 0.19                          | 0.12*                          | -          | -0.16                        | -0.12                      | -0.21       |
|                      |            | [0.11]                          | [0.13]                         | [0.07]                          |           | [0.13]                         | [0.11]                        | [0.32]      |
| Inv. Outflows (t) × DUMMY | -         | -0.45**                      | -0.25**                        | -0.51***                      | -          | -0.14                         | -0.03                      | 0.62*       |
|                      |            | [0.18]                          | [0.1]                         | [0.08]                          |           | [0.18]                         | [0.16]                      | [0.36]      |
| Inflows from Sec. (t) × DUMMY | -         | 0.19                          | -0.02                          | 0.33***                      | -          | 0.42                         | 0.66***                  | 1.35        |
|                      |            | [0.14]                          | [0.08]                         | [0.08]                          |           | [0.5]                         | [0.17]                        | [1.6]       |
| Others (t) × DUMMY   | -         | -0.33*                        | 0.18                          | -0.4**                        | -          | 0.49                         | 0.42                      | -0.4***     |
|                      |            | [0.19]                          | [0.17]                         | [0.16]                          |           | [0.14]                         | [0.26]                        | [0.06]      |
| Fund controls        | Yes      | Yes                           | Yes                           | Yes                           | Yes     | Yes                           | Yes                        | Yes       |
| Adjusted R-squared   | 0.35      | 0.39                          | 0.34                          | 0.4                           | 0.18      | 0.21                          | 0.2                       | 0.21      |
| Number of observations | 4 908    | 4 592                         | 4 592                          | 4 908                         | 5 971     | 5799                          | 5799                     | 5 971     |

The table reports the results of regressions including time-fixed effects and individual fund-fixed effects for the subset of funds excluding institutional investor funds. For the dummy variables, columns 2 and 3 are estimated for bond funds using the average haircut and the average share on amount out, respectively. For equity funds, the illiquidity dummy variables go as follows: average market cap decile and volumes traded decile respectively. To save space, I do not report estimates for fund control variables. Values shown in parentheses are double clustering robust standard errors by funds. *** 1% significance; ** 5% significance; * 10% significance.
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Table 10  Baseline results without mixed funds

|                      | Bond   | Equity |
|----------------------|--------|--------|
| Inv. Inflows (t)     | 0.43***| 0.23***|
|                      | [0.09] | [0.03] |
| Inv. Outflows (t)    | −0.69***| −0.21***|
|                      | [0.14] | [0.03] |
| Inflows from Sec. (t)| 0.53***| 3**    |
|                      | [0.03] | [1.46] |
| Others (t)           | 0.61***| 0.34***|
|                      | [0.12] | [0.03] |
| Fund controls        | Yes    | Yes    |
| Adjusted R-squared   | 0.39   | 0.07   |
| Number of observations| 3 574  | 2 743  |

The table reports the results of the regressions as specified in Eq. 5, i.e., including time-fixed effects and individual fund-fixed effects and after excluding mixed strategy funds. To save space, I do not report estimates for fund control variables. Values shown in parentheses are double-clustering robust standard errors. *** 1% significance; ** 5% significance; * 10% significance.
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