Fragility in bond mutual funds: The role of investor base*

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PRELIMINARY AND INCOMPLETE

Bond mutual funds transform a portfolio of illiquid assets into liquid shares for their investors. We document that more than a quarter of these investors are other open-ended mutual funds using novel, security-by-security data on investor holdings in the Euro area. We further show that it is precisely these fund owners that were the most inclined to redeem fund shares during the unprecedented "dash for cash" in March 2020. On average, fund shares with higher fund ownership faced more than double the outflows compared to fund-shares with higher household ownership. This gap is not driven by time-varying differences in fund portfolios. Rather, our findings point to the cross-ownership between institutions as an important source of fragility in the non-bank intermediary sector.

Keywords: mutual funds, runs, liquidity, investor type, March 2020 liquidity crisis

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1. Introduction

Liquidity transformation by bond mutual funds renders them vulnerable to runs. Most recently, bond funds suffered large run-like outflows in March 2020 (Falato, Goldstein, and Hortaçsu, 2021), which threatened to de-stabilize broader financial markets (Ma, Xiao, and Zeng, 2020; Vissing-Jorgensen, 2020) and led to large-scale central bank interventions (e.g., Breckenfelder and Hoerova, 2020). One common explanation for these outflows was a collective "dash for cash" by consumers and firms in need of liquidity at the outset of the COVID-19 pandemic.

While the large aggregate outflows point to an aggregate dash for cash by investors, they do not reveal the identity and incentives of the investor base. We show that more than a quarter of fund shares are owned by other open-ended funds and that it is these fund owners that redeemed their fund shares en masse and amplified panic-driven sales by other investors. On average, fund shares in which investment funds represent at least 25% of the investor base experienced 5.38 percentage points larger outflows during the Covid-19 crisis than fund shares with lower investment fund ownership. In contrast, fund-shares in which households represent at least 25% of the investor base were less affected, with outflows lower by 4.68 percentage points during the sample period.

Our findings imply that the cross-holdings of mutual funds represents an important source of fragility in the non-bank intermediary sector. We confirm that our results are not driven by a selection of fund type or asset class by comparing investors within the same fund and at the same time. Our results are also not solely driven by the gap in investor sophistication between institutional and retail investors. For example, we find that fund-shares owned more by insurance companies, which are also institutional investors, experienced 1.02 percentage point lower outflows than fund shares owned less by insurance companies during the Covid-19 crisis. Rather, it is the open-ended nature of mutual funds coupled with their cross-ownership structure that allows for initial fund outflows to amplify and trigger widespread redemptions of fund shares.

We arrive at these answers by constructing a novel dataset on the composition of investor base at the fund-share level. As part of the Euro Area Securities Holdings Statistics, we observe investor holdings for each fund share across more than a dozen of different investor types, including households, insurance corporations, pension funds, banks, and investment funds. We further merge fund holdings, fund flows, and other fund characteristics using the Refinitiv's Lipper database. We use the March 2020 liquidity crisis as a laboratory for our analysis as this crisis featured unprecedented daily outflows from bond funds, averaging to about 0.5% of fund total net assets (TNA) on a daily basis in the week of March 16, 2020 (see Figure 1). We measure fund ownership based on the pre-pandemic investor holdings in 2019-Q4. We require that euro area ownership of a fund share in our dataset is at least 50% of total to ensure sufficiently granular coverage of the investor base.[1]

To summarize investor base heterogeneity across fund-shares, we consider three types of splits for each fund share within a fund. In the first split, each fund share is placed in one of the two bins: higher/lower ownership by elastic investors, where we classify investor types into elastic/inelastic following Koijen, Koulischer, Nguyen, and Yogo (2021). In the second split, each fund share is placed in one of the two bins: higher/lower expense ratio, where lower expense ratio proxies for ownership by sophisticated investors, following Schmidt, Timmermann and Wermers (2016). We explore two different ways of determining cutoffs to place a fund-share into a higher versus a lower bin: 1) cutoff based on the corresponding median value across all fund shares in our sample; 2) cutoff based on the corresponding relative ranking within the same fund. In the third split, we zoom in on the behavior of the four largest shareholders of bond mutual funds in our sample: Investment funds, Foreign investors, Households, and Insurance corporations (see

[1] In addition, we require that we have at least two such fund-shares per fund, to be able to conduct our within-fund analysis which holds fund portfolio fixed and exploits variation across fund-shares of the same fund. Schmidt, Timmermann and Wermers (2016) were the first to exploit the multiple share class structure of funds in their analysis of money market fund runs. See also Coppola (2021) who studies the role of ownership base for nearly identical bonds issued by the same firm to causally identify the elasticities of bond returns to investor base composition.

Table 1). We again place each fund share in one of the two bins: higher/lower than 25% ownership by investor type X where X is one of the four afore-mentioned investor groups.

Our empirical methodology aims to capture the impact of within-fund variation in fund-share ownership on fund-share outflows. We absorb all fund-specific effects so that we can rule out that our results are driven by differences in performance, portfolios or risks *across* funds.

Our findings can be summarized as follows. When splitting investor base into higher-versus-lower elastic investor ownership, we find that while both elastic and inelastic investor types redeemed shares during the March 2020 liquidity crisis, elastic investors did to a significantly higher extent, with the difference in outflows across higher-versus-lower elastic investor ownership fund shares amounting to as much as 7 percentage points. When considering the split on sophisticated versus unsophisticated investors, as proxied by the fund-share expense ratio, we find that fund shares with more sophisticated shareholders faced much higher redemptions, with the difference in outflows amounting to as much as 5.12 percentage points compared to fund shares with less sophisticated shareholders. Lastly, when analyzing the split on the higher/lower than 25% ownership by the four largest shareholder groups in our sample, we find that fund-shares with higher Household ownership suffered the least from investor runs while fund-shares with higher Investment fund ownership suffered the most from runs. Our results are suggestive of runs being driven by elastic, sophisticated investors who may have also been affected by the "dash-for-cash" in March 2020.

In the aftermath of the March 2020 liquidity crisis, a discussion intensified on whether there is a need to regulate liquidity in mutual funds, mirroring regulation imposed on banks in the aftermath of the Global Financial Crisis that requires banks to hold liquid assets against unstable funding liabilities. The question is whether investment funds should similarly self-insure against runs by their investors. Our findings have potential implications for this discussion since they shed light on which

investors are more likely to redeem their shares in a liquidity crisis.

2. Literature Review

Our paper relates to several strands of the literature. First, we contribute to the literature on the financial stability risks of non-bank liquidity transformation. Chen, Goldstein, and Jiang (2010) and Goldstein, Jiang, and Ng (2017) are the first to show that open-ended mutual funds are subject to first-mover advantages. Several papers shed light on the illiquidity of fund assets and their portfolio management strategies as important factors in the determining fund run risk (Chen, Goldstein, and Jiang, 2010; Chernenko and Sunderam, 2016; Morris, Shim, and Shin, 2017; Zeng, 2017). More closely related to us are Chen, Goldstein, and Jiang (2010) and Schmidt, Timmermann and Wermers (2016), who examine the effect of institutional investors in driving fund runs. While Goldstein, Jiang, and Ng (2017) show that larger institutional investors reduce the likelihood of runs by internalizing outflow-driven externalities, Schmidt, Timmermann and Wermers (2016) highlight that institutional investors are more likely to run from money market funds than their less sophisticated retail counterparts. We highlight the importance of investor heterogeneity even within institutional investors, which stems from differences in investment mandate and elasticity. In particular, we uncover a novel and important driver of fund fragility in the cross-holding of mutual fund shares by other mutual funds. This cross-holding between mutual funds is a distinct and complementary source of fragility as the asset commonality between mutual fund portfolios, as pointed out by Falato, Hortacsu, Li, and Shin (2020).

We also contribute to the understanding of mutual fund runs during the Covid-19 crisis. Falato, Goldstein, and Hortaçsu (2021) show that the illiquidity of fund assets and the vulnerability to fire sales were important factors in explaining fund outflows in this episode, along with the exposure to sectors most hurt by the Covid-19 pandemic. Ma, Xiao, and Zeng (2020) and Haddad, Moreira, and Muir

(2020) link significant liquidity strains in Treasuries and high-quality bond markets during the pandemic to asset sales by funds trying to generate liquidity to satisfy investor redemptions. We add an important element to understanding the anatomy of fund runs during the Covid-19 crisis. We document that fund shares held more by investment funds experienced substantially larger outflows, which highlights the significance of investor-base heterogeneity and mutual fund cross-holdings in explaining the unprecedented outflows from bond funds.

Finally, our results suggest that the composition and concentration of mutual funds' investor base is worth monitoring by regulators. This relates to the broad range of policy measures introduced to stabilize non-bank intermediaries during and following the Covid-19 crisis. Breckenfelder and Hoerova (2020) assess the effectiveness of central bank asset purchases and additional liquidity provision to banks in alleviating the crisis faced by mutual funds in the euro area. They show that asset purchases were particularly effective in stopping fire-sale dynamics and staving off runs on bond mutual funds. Li, Li, Machiavelli, and Zhou (2021) focus on money market funds (MMFs) and argue liquidity restrictions on investors may have exacerbated the run on prime MMFs during the onset of the COVID-19 crisis. Finally, swing pricing has been increasingly adopted, which can prevent large outflows during crisis times (Jin, Kacperczyk, Kahraman, and Suntheim, 2021) and improve liquidity provision to investors (Ma, Xiao, and Zeng, 2022).

The remainder of the paper is organized as follows. In Section 3, we describe the data we use. In Section 4, we outline our empirical methodology. In Section 5, we present the results. Section 6 concludes.

3. Data

Our analysis relies on two main data sources: (1) the Securities Holding Database Aggregated by Sector (SHSS) collected by the Eurosystem which contains quarterly information on holdings of all securities held in the Euro area or with a euro area

custodian; and (2) the Refinitiv's Lipper for Investment Fund Management database (Lipper for short), which covers detailed fund-level data including daily inflows and outflows, performance, security-level portfolio holdings, and additional static information on the funds and fund families. In what follows, we describe the two data sources in turn. We then present summary statistics for the sample resulting from the merge between the SHSS and Lipper databases.

3.1 The SHSS database

The SHSS database provides holding information - at the level of each individual security – for all securities held in the euro area (plus some additional non-euro-area European countries) or with a euro area custodian. The information is collected quarterly. There are two additional key dimensions of the dataset: 1) investor type holding a security and 2) an investor's country of origin. The holding information is complemented with the Centralized Securities Database (CSDB) that contains information such as issuer name and outstanding amount, price, and precise instrument type.

The Investor dimension of the dataset is defined according to the 2010 European System of Accounts and distinguishes between more than a dozen different investor types. For our purposes, we group investors into eleven categories: 1) Households, 2) Deposit-taking corporations (referred to as "Banks"), 3) General government ("Government"), 4) Insurance corporations, 5) Pension funds, 6) Money market funds, 7) Non-Money market fund Investment funds ("Investment funds"), 8) Non-financial corporations, 9) Other financial intermediaries – which correspond to the sum of holdings of Financial auxiliaries, Captive financial institutions and money lenders, as well as another bundled category called 'Other financial intermediaries, except insurance corporations and pension funds', and 10) Other euro area investors, capturing any remaining euro area investor holdings. The last, eleventh, category is Foreign investors. We compute the Foreign investors holdings as the difference between the total net assets of the fund-share class and the total

market value of euro area investor holdings as reported in the database, which is similar to the approach employed by Koijen, Koulischer, Nguyen, and Yogo (2021) who worked with the SHSS data in a different context.

The country dimension of the dataset includes investor country of origin as long as (i) investors resides in the euro area, such as banks in Italy or households in France, (ii) investors reside in non-euro area EU countries that also collect SHS investor data (Bulgaria, the Czech Republic, Denmark, Hungary, Poland and Romania), and iii) country of origin can be recorded for non-resident investors' holdings that are deposited with a euro area custodian, such as US investors' holdings of German securities deposited in Luxembourg.

3.2 The Lipper database

From Refinitiv's Lipper for Investment Management, we retrieve fund-share level data on flows, performance, expense ratios and fund-level information on portfolio holdings. We restrict our sample to open-end bond mutual funds using information on the fund-type from (1) the closed-end flag available in Lipper, which indicates whether a fund has a fixed number of shares or units in issue; (2) the asset universe flag available in Lipper, giving information on the types of securities favored by funds (Bond, Equity, Alternatives, Mixed Assets, Real Estate, Money Market); and (3) data on a fund's legal structure.

Fund flow information, total net assets (TNA) and trading prices are available at daily frequency. Security-level fund holdings information is available at monthly frequency. In some cases, reporting is quarterly. We observe the portfolio holdings at market valuation and also as shares of the fund's total holding. Lipper sources the portfolio holdings directly from the fund management companies. Unavailable fund holdings are typically linked to non-disclosure agreements and embargo periods.

We construct the daily net fund flows variable as is standard in the literature (see, e.g., Falato, Goldstein and Hortaçsu, 2021, for a recent example):

$$Flows_{i,t} = \frac{TNA_{i,t} - (1 + r_{i,t}) * TNA_{i,t-1}}{TNA_{i,t-1}}$$

where $TNA_{i,t}$ is total net assets of fund i at day t and $r_{i,t}$ is the fund's daily return. We analyze flows on a fund-share level.

3.3 Summary statistics

Our merged SHSS-Lipper sample comprises of security-level panel of bond mutual fund-shares that includes information on the inflows and outflows at the daily-fund-share class level. Our daily flows data spans the period from January 2020 to June 2020. We include additional information such as fund share performance and expense ratios.

We measure fund ownership on the fund-share level in 2019-Q4, prior to the outbreak of the COVID-19 pandemic. To ensure a sufficiently granular coverage of investor base, we require that euro area ownership of a fund share in our dataset is at least 50% of total. In addition, we require that we have at least two such fund-shares per fund, to be able to conduct our within-fund analysis which holds fund portfolio fixed and exploits variation across fund-shares of the same fund.

The match between Lipper and SHSS is unique using the security identifier (so called ISIN) of the fund-share. The match yields 3,206 fund-shares, corresponding to 524 distinct bond mutual funds. Out of the 3,206 fund-share classes, the criterion of at least 50% euro area ownership for two fund-shares per fund is satisfied for 1,593 fund shares. This is our final sample. For this set of fund-shares, total net assets aggregate to 218.7 billion, of which 161.7 billion (74%) are owned by euro area investors in 2019-Q4.

[Table 1: Summary statistics]

Table 1 presents summary statistics for the ownership base in our sample, based on 2019-Q4 values. It shows the distribution of holdings, at the fund-share level, across eleven investor types (see Section 2.1 for details). The statistics (means and standard deviations) are reported both for the holding volumes (in EUR mil.) as well as for holding shares in % of total fund-share TNA (obtained from Lipper and

converted to Euros first before calculating the %).

Table 1 reveals four main shareholder types of bond mutual funds in our sample: Investment funds (on average, 27.9% in total), Foreign investors (on average, 25.6% in total), Households (on average, 24.5% in total) and Insurance corporations (on average, 12.5% in total). In comparison, the next three shareholder types – Non-financial corporations, Pension funds and Government – hold markedly lower shares on average, amounting to between 2.3% and 3.2% in total.

4. Empirical design

To summarize investor base heterogeneity across fund-shares, we consider three types of splits for each fund share within a fund.

In the first split, each fund share is placed in one of the two bins: higher/lower ownership by elastic investors, where we classify investor types into elastic/inelastic following Koijen, Koulischer, Nguyen, and Yogo (2021). Koijen et al. (2021) define the following investor types as elastic investors: Investment funds, Foreign investors, Banks, Money market funds, and Other financial institutions. The remaining investors are classified as inelastic.[2]

In the second split, each fund share is placed in one of the two bins: higher/lower ownership by sophisticated investors, where sophisticated investors are defined as those with lower expense ratio, following Schmidt, Timmermann and Wermers (2016).

In the third split, we zoom in on the behavior of the four largest shareholders of bond mutual funds in our sample: Investment funds, Foreign investors, Households, and Insurance corporations (see Table 1). We again place each fund share in one of the two bins: higher/lower than 25% ownership by investor type X

[2] We note that splitting institutional investors according to their holding horizon (short versus long), as in Cella, Ellul, and Giannetti (2013), would yield similar results to elastic versus inelastic. In their paper, the short-horizon investors are found among hedge funds, bank trusts, investment companies, and independent investment advisors, with mutual fund category being close to the average of the sample. On the other hand, long-horizon investors are found among insurance corporations, pension funds and university and foundation endowments.

where X is one of the four afore-mentioned investor groups.

For the first two splits of investors (elastic vs inelastic; sophisticated vs unsophisticated), we consider two definitions of the cut-off for being placed into higher versus lower bin: 1) cutoff based on the corresponding median value across all fund shares in our sample; 2) cutoff based on the corresponding relative ranking within the same fund. We describe each of these cutoffs in turn.

4.1 Median cutoff

Under the median cutoff value, we first compute the median value of the relevant split across all fund shares in our sample and then classify each fund share as being above/below that median value.

Specifically, when working with the split on elastic versus inelastic investors, we determine the median holdings by elastic investors across all fund shares in the sample to be 51.3%. When working with the split on sophisticated versus unsophisticated investors, as proxied by the expense ratio, we find that the median expense ratio in our sample is 0.73. Table 2 links the expense ratio to the underlying ownership base. It presents the distribution of investor types in the higher/lower expense ratio bins. While investment funds are more represented in the lower expense ratio bin compared to the high expense ratio bin, the opposite is the case for households.

A possible disadvantage of using the median cutoff is that those funds whose fund shares all fall into one of the bins are de facto dropped from the analysis. This is why we consider an alternative cutoff, which is based on the relative ranking within each fund.

4.2 Relative ranking

Under the relative ranking, we take, for each fund, two fund shares with the largest difference on the relevant dimension (in ownership by elastic investors in the first split and in the expense ratios in the second split).

This approach has an advantage that no funds are dropped from the analysis (unlike in Section 3.1 above). A potential disadvantage of this approach could be that the largest difference in ownership in a given fund may be quite small. Consider, for example, a fund with two fund shares - one fund share has 80% elastic investor ownership and the other 75% elastic investor ownership. In this case, we would place these two fund shares in separate bins; however, we should not expect big differences in flows across these two fund shares. If this happens, it could weaken the results we obtain when using this approach.

4.3 Regression set-up

We aim to link the evolution of fund-share flows to the fund-share investor base.

We use the following regression set-up:

$$\Delta flows_{\mathrm{i,t}} = \beta_0 + \sum_{k=1}^{T} \beta_k \; I_{k,t} \times InvestorType_i + \sum_{k=1}^{T} \varphi_k \; I_{k,t} + \mu_{fund} + \varepsilon_{i,t}$$

where $\Delta flows_{i,t}$ stands for the cumulative daily fund-share flow of fund-share *i* at time *t* (difference to February 3, 2020). The dummy variables $I_{k,t}$ take on the value of 1 for period k and zero otherwise. We consider both daily periods and weekly periods over the sample horizon. The variable $InvestorType_i$ is equal to 1 if a fund-share *i* is held by a specific investor type relatively more, e.g., above-the-median holding amounts or above 25% ownership in the fund share. Lastly, μ_{fund} are fund fixed effects that allow us to compare different fund shares within the same fund. $\varepsilon_{i,t}$ is the error term.

5. Results: Who runs on bond mutual funds?

We take a first look at the data by considering fund flows and performance across fund shares, splitting them according to ownership by the four largest shareholders of bond mutual funds as identified in Table 1 (Investment funds, Households, Insurance corporations, and Foreign investors). We then present results for the three splits we consider: higher/lower elastic investor ownership base (Section 4.2); higher/lower sophisticated ownership base (Section 4.3); and

higher/lower than 25% ownership by investor type X where X is one of the four afore-mentioned investor groups (Section 4.4).

5.1 A first look at the data

In this Subsection, we consider fund flows and performance across fund shares, splitting them according to ownership by the four largest shareholders as identified in Table 1 (Investment funds, Households, Insurance corporations, and Foreign investors). Our ownership cutoff is 25% in total so that we assign any fund share in which Investment funds hold at least 25% to a group "Investment funds hold at least 25%" and so on, for each of the four investor types. We then plot fund flows and fund performance for these four groups of fund shares.

Considering cumulative fund flows over the January – June 2020 period (Figure 2) we document that flows across these four groups of fund shares followed the same pattern prior to late-February 2020. Fund flows trend – in parallel – upwards. However, during the run period of March 2020, fund flows differ significantly across these four groups. Fund flows decline for all groups but differentially so, depending on the fund-share ownership. The largest average outflow - over 10% - is apparent for fund-shares with Investment funds holding at least 25% of TNA. The second largest outflow - about 9% - is visible for fund-shares with Foreign investors holding at least 25% of TNA. Fund shares linked to Households or Insurance corporations suffered lower outflows of about 4% and 6%, respectively.

[Figure 2: Fund flows]

By the end of March 2020, flows stabilize across all fund-shares, irrespective of the investor base. This finding is consistent with Breckenfelder and Hoerova (2020) who document that the ECB's large-scale pandemic purchase program - which was

announced in the evening of March 18, 2020 and started being implemented as of March 26, 2020 – was successful in stopping runs on bond mutual funds. Between March 26 and June 30, 2020, flows increase by about 1 percentage point across all groups. This implies that fund flows remained significantly below their February 2020 levels. For example, for fund-shares with Investment funds holding at least 25% of TNA, flows remained significantly lower till the end of June 2020, with flows down by about 9% relative to before the run period.

Turning to fund performance over the January – June 2020 period (Figure 3), we show that fund performance does not differ significantly before or during the run period of March 2020 across the four groups. Figure 3 shows fund market value changes across the four groups of fund shares. While fund-shar performance increased slightly prior to the beginning of the run, it declined sharply during the run episode. Importantly, fund-share performance developed in a similar fashion for all funds, irrespective of their investor base. Fund-shares lost about 12% of their value on average. The value loss stopped with the announcement of the ECB's large scale pandemic purchase program on March 18, 2020 and started recovering as of March 26, 2020 when the ECB started buying securities on the secondary market. Fund performance continued to recover until the end of June 2020 with values being off by about 2% relative to the levels prior to the run.

[Figure 3: Fund performance]

The fact that there are no differences in fund performance across the four groups is important. It suggests that the very different run dynamics we document in Figure 2 is unlikely to be driven by investors reacting to different performance. Instead, the different dynamics of outflows seems to be linked to the different behavior of investors as such. In what follows, we investigate further run dynamics across different investor types, exploiting variation across fund-shares of the same fund.

5.2 Elastic versus inelastic investors

In this Subsection, we present results for the fund-share split based on higher/lower ownership by elastic investors (Table 3). Koijen, Koulischer, Nguyen, and Yogo (2021) define the following investor types as elastic investors: Investment funds, Foreign investors, Banks, Money market funds, and Other financial institutions. The remaining investors are classified as inelastic. As discussed in Section 3, we consider two definitions of the cut-off for being placed into higher versus lower bin, one based on the median elastic ownership value across all fund shares in our sample and another based on the relative ranking of ownership within the same fund. All regressions exploit variation across fund-shares of the same fund (see Section 3 for details).

[Table 3: Fund flows by elastic versus inelastic investors]

Table 3, columns 1-3 present results for cumulative flows based on the median cutoff. Column 1 shows the development of fund flows for fund-shares with more inelastic shareholder base. By the end of March 2020 (when cumulative flows reached their minimum), cumulative outflows amounted to 3.67%, compared to the beginning of February. The outflows are somewhat higher – 4.28%= 0.61%-(-3.67%) - if we take the week of February 20, just prior to the run unfolding, as the base. Column 2 shows that fund-shares with more elastic investor base suffered from higher redemptions. By the end of March 2020, cumulative outflows amounted to 10.72%, compared to the beginning of February (the outflows amounted to 11.46% if we take the week of February 20 as the base). Column 3 shows the difference in fund flows among fund-shares with higher/lower elastic investor ownership. At the start of the run, there is an average differential outflow of 0.90 percentage points for fund-share with higher elastic investor ownership. By the end of the run period, this outflow differential amounts to 7.05 percentage points.

Table 3, columns 4-7 present results for cumulative flows based on the relative cutoff. The structure of columns 4-6 mimics that of columns 1-3. Column 4 shows that

by the end of March 2020, cumulative outflows for fund-share with higher inelastic investor ownership amounted to 4.61%, compared to the beginning of February (the outflows are 5.20% if we take the week of February 20 as the base). Column 5 shows that fund-shares with the more elastic investor base suffered from higher redemptions: cumulative outflows of 8.62% by the end of March, compared to the beginning of February (9.17% compared to the week of February 20). Column 6 shows the difference between fund-shares with higher/lower elastic investor ownership. While the average differential outflow is 0.76 percentage points for fund-share with higher elastic investor ownership at the beginning of run period, this differential increases to 4.02 percentage points by the end of the run period. While all these differentials are statistically significant at the 1% level, economic magnitudes are somewhat smaller for the relative split compared to the median split discussed in the previous paragraph. This could happen if the split based on the relative cutoff assigned relatively similar fund shares in the opposite bins (see Section 3.2 for details on this discussion). We therefore apply an additional condition requiring that the elastic investor ownership difference between fund-shares of the same fund assigned to the higher/lower bins is at least 25%. Column 7 reports the regression results. Given that we are requiring a larger difference across fund shares, we would expect a larger differential compared to Column 6. This is indeed the case, with the outflow differential between elastic/inelastic-owned fund-shares reaching 5.81 percentage points by the end of March 2020.

In sum, while both elastic and inelastic investor types redeemed shares during the March 2020 liquidity crisis, elastic investors did to a much higher extent, with the difference in outflows across higher-versus-lower elastic investor ownership fund shares amounting to as much as 7 percentage points.

5.3 Sophisticated versus unsophisticated investors

In this Subsection, we present results for the fund-share split based on higher/lower ownership by sophisticated investors (Table 4). Schmidt, Timmermann, and

Wermers (2016) use fund shares' expense ratio to split investors into sophisticated (lower expense ratio) and unsophisticated (higher expense ratio). As illustrated in Table 2 and discussed in Section 3.2, investment funds are more represented in the lower expense ratio bin compared to the high expense ratio bin while the opposite is the case for households. We again consider two definitions of the cut-off for being placed into higher versus lower bin – one based on the median value for the expense ratio across all fund shares and another based on the relative value for the expense ratio within the same fund. All regressions exploit variation across fund-shares of the same fund (see Section 3 for details).

[Table 4: Fund flows by sophisticated versus unsophisticated investors]

Table 4, columns 1-3 present results for cumulative flows based on the median cutoff. Column 1 shows the development of fund flows for fund-shares with above-the-median expense ratios (unsophisticated shareholders). By the end of March 2020 (when cumulative flows reached their minimum), cumulative outflows amounted to 6.60% compared to the beginning of February (7.12% if compared to the week of February 20). Column 2 shows that fund-shares with below-the-median expense ratios (sophisticated shareholders) suffered from even higher redemptions. By the end of March, cumulative outflows amounted to 9.21% compared to the beginning of February (and to 9.62% if compared to the week of February 20). Column 3 shows the difference in fund flows among fund-shares with higher-versus-lower expense ratios. By the end of the run period, the outflow differential amounts to 2.63 percentage points.

Table 4, columns 4-7 present results for cumulative flows based on the relative cutoff for the expense ratio. The structure of columns 4-6 mimics that of columns 1-3. Column 4 shows that cumulative outflows for fund-share with relatively higher expense ratios (unsophisticated shareholders) amounted to 5.25% if compared to the beginning of February (5.74% if compared to the week of February 20). Column 5 shows that fund-shares with relatively lower expense ratios (sophisticated

shareholders) suffered cumulative outflows of 9.71% by the end of March compared to the beginning of February (10.13% compared to the week of February 20). Column 6 shows the differential between fund-shares with higher/lower expense ratios which reached 4.45 percentage points by the end of the run period. Column 7 reports regression results when we additionally require that a gap between higher/lower expense ratio fund shares within a fund is at least 0.5. As expected, we obtain a larger outflow differential in this specification, amounting to 5.12 percentage points by the end of the run period.

In sum, fund shares across the board suffered from outflows. However, fund shares with more sophisticated shareholders saw much higher redemptions, with the difference in outflows amounting to as much as 5.12 percentage points compared to fund shares with less sophisticated shareholders.

5.4 Investor-type analysis

In this subsection, we exploit the granularity of our dataset, to analyze which investors ran on bond mutual funds in March 2020 (Table 5). We focus on the largest shareholders of funds - Investment funds, Households, Insurance corporations and Foreign investors (see Table 1). We place each fund share in one of the two bins: higher/lower than 25% ownership by investor type X where X is one of the four afore-mentioned investor groups. As before, we exploit variation across fund shares of the same fund.

Table 5, columns 1-2 present results for cumulative flows based on high/lower ownership by Investment funds. Column 1 shows the development of fund flows for fund-shares with at least 25% Investment fund ownership base. By the end of March 2020 (when cumulative flows reached their minimum), cumulative outflows amounted to 10.54% compared to the beginning of February (11.28% if compared to the week of February 20). Column 2 shows the differential among fund-shares with higher/lower Investment fund ownership. High Investment fund ownership funds are more affected by runs. At the start of the run, the average differential outflow is

0.45 percentage points. By the end of the run period, the outflow differential amounts to 5.38 percentage points.

[Table 5: Fund flows by investor type]

Table 5, columns 3-4 present results for cumulative flows based on the split on ownership by Households. Column 3 shows the development of fund flows for fund share with at least 25% Households ownership. By end-March, cumulative outflows amounted to 4.38% (5.11%) compared to the beginning of February (week of February 20). Column 4 shows the differential among fund-shares with higher/lower Household ownership. Fund-shares with higher Household ownership are *less* affected by runs. At the start of the run period, average (positive) flow differential is 0.90 percentage points while by the end of the run period, the (positive) flow differential amounts to 4.68 percentage points.

Table 5, columns 5-6 present results for cumulative flows based on the split on ownership by Insurance corporations. Column 5 shows the development of fund flows for fund-shares with at least 25% ownership by Insurance corporations. Cumulative outflows reached the peak of 5.86% (6.30%) in the week of April 2 compared to the beginning of February (week of February 20). Column 6 shows the differential among fund-shares with higher/lower Insurance corporations ownership. Fund-shares with higher Insurance corporations ownership are *less* affected by runs. The (positive) flow differential reached the peak of 1.02 percentage points by the end of March 2020.

Table 5, columns 7-8 present results for cumulative flows based on the split on ownership by Foreign investors. Column 7 shows the development of fund flows for fund-shares with at least 25% Foreign ownership. Cumulative outflows amounted to 8.97% (9.73%) by the end of March compared to the beginning of February (week of February 20). Column 8 shows the differential among fund-shares with higher/lower Foreign investor ownership. Fund-shares with higher Foreign ownership suffer more from runs. At the start of the run, there is an average differential outflow of 0.37

percentage points. By the end of the run period, the outflow differential amounts to 3.05 percentage points.

We also run an additional, more stringent, specification, in which we add calendar date time fixed effects, interacted with fund fixed effects (Table 6). In this specification, the only variation left are the differences, within the same fund, across fund shares with different investor bases. Column 1 presents the differential for cumulative flows based on high/lower ownership by Investment funds. Also this specification confirms that high Investment fund ownership funds are more affected by runs. By the end of the run period, the outflow differential amounts to 5.8 percentage points.

[Table 6: Fund flows by investor type - Fund-time fixed effects]

Table 6, Column 2 presents the differential for funds held more by Households. Also here, we confirm that fund-shares with higher Household ownership are *less* affected by runs, with estimates quantitatively similar to those in Table 5. At the start of the run period, average (positive) flow differential is 0.94 percentage points while by the end of the run period, the (positive) flow differential amounts to 4.5 percentage points. Results for fund-shares held by Insurance corporations are also quantitatively similar to Table 5 while results for the Foreign sector are smaller, with the maximum outflows differential reaching 1.23 percentage points in the week of March 26 (compared to 3 percentage points in Table 5).

Figure 4 presents the key take-aways from the fund-time fixed effects specification graphically, showing regression results which use daily interactions instead of weekly interactions. The figure confirms that: 1) there were no differential outflows prior to the onset of the run at the end of February 2020; 2) Fund-shares with at least 25% Investment funds ownership experienced large negative differential in flows during the run period (larger outflows compared to the other fund-shares within the same fund); and 3) Fund-shares with at least 25% Household ownership experienced positive differential in flows during the run period (smaller outflows

compared to the other fund-shares within the same fund).

[Figure 4: Differential impact by investor type]

In sum, our results suggest that fund-share investor base does matter for fund outflows. Looking at the four largest bond mutual fund shareholder groups, fund-shares with higher Household ownership suffered the least from investor runs while fund-shares with higher Investment fund ownership suffered the most from runs.

6. Conclusion

In this paper, we analyze the sources of fragility in bond mutual funds, focusing on the role of fund ownership composition. We use confidential, security-by-security data on investor base of bond fund-shares which allow us to differentiate investor holdings across more than a dozen different investor types. We study run dynamics across different fund-shares of the same fund (thus holding the underlying fund portfolio fixed), to shed light on run incentives of different investors during the liquidity crisis of March 2020. We find that fund-shares in which Investment funds represent at least 25% of the investor base were significantly more affected by runs compared to fund shares with lower Investment fund ownership, within the same bond fund. The differential amounts to 5.38 percentage points. On the other hand, fund-shares in which Households or Insurance corporations represent at least 25% of the investor base were less affected by runs, with outflows lower by 4.68 and 1.02 percentage points, respectively. These differences are economically significant: fund-shares with higher Investment funds ownership faced more than double the outflows compared to fund-shares with higher Household ownership. Our results are suggestive of runs being driven by elastic, sophisticated investors who were also affected by the "dash-for-cash" in March 2020.

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FIGURE 1 – BOND MUTUAL FUND FLOWS, FEBRUARY - APRIL 2020

This figure depicts the evolution of daily average fund flows before and after the initial COVID-19 pandemic shock. Daily flows are calculated as

$$flows_{i,t} = 100 * (TNA_{i,t} - (1 + r_{i,t}) * TNA_{i,t-1}) / TNA_{i,t-1}$$

where $TNA_{i,t}$ is total net assets of fund i at day t and $r_{i,t}$ is the fund's daily return. The vertical red dotted lines depict two key events: 1) the onset of runs in late February 2020 and 2) the end of runs following large-scale interventions of the European Central Bank, ECB (the ECB's pandemic purchases were announced on March 18, 2020 and started being implemented as of March 26, 2020). Source: Lipper Refinitiv and authors' calculations.

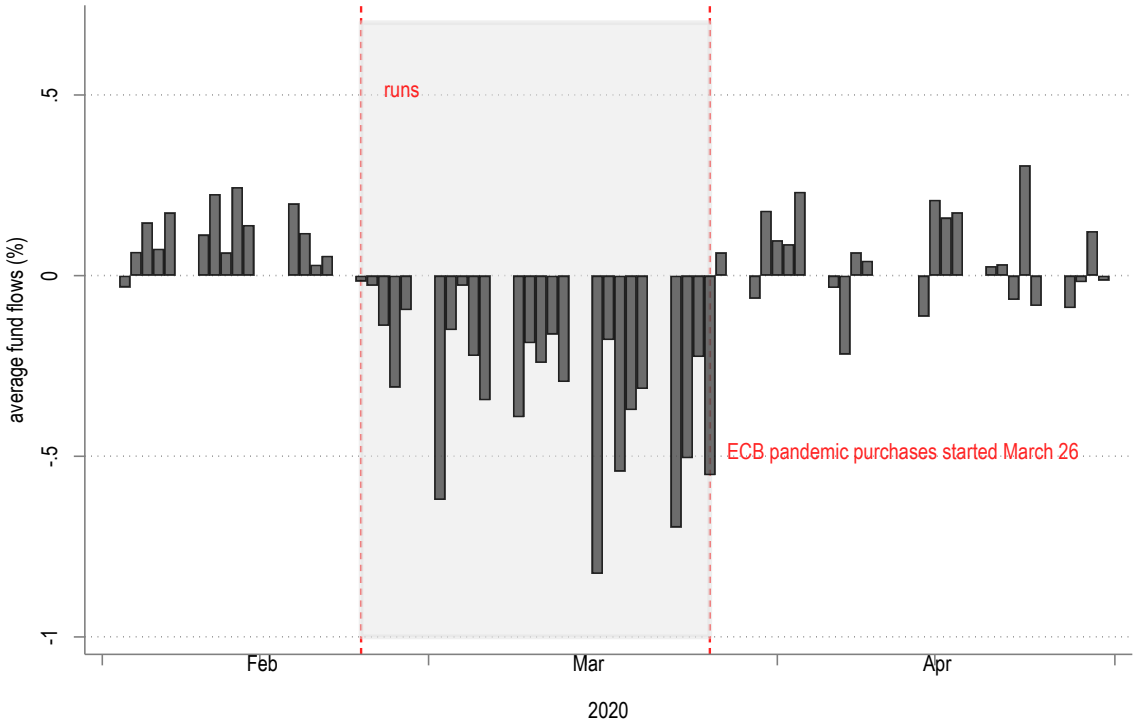

FIGURE 2 – FUND FLOWS BY INVESTOR TYPE

This figure gives the evolution before and after the initial COVID-19 shock of March 2020 of daily average cumulative fund flows (in %) of bond mutual fund share-classes after splitting them into 4 groups, depending on their investor base in 2019-Q4. Daily flows are calculated as

$$flows_{\mathrm{i,t}} = 100 * (TNA_{\mathrm{i,t}} - (1 + \mathrm{r_{i,t}}) * TNA_{i,t-1}) \,/\, TNA_{i,t-1}$$

where $TNA_{\mathrm{i,t}}$ is total net assets of fund i at day t and $\mathrm{r_{i,t}}$ is the fund's daily return. (i) The blue line depicts daily average cumulative flows of fund-shares with at least 25% of their TNA held by Households; (ii) the red dotted line gives the daily average cumulative flows of fund-shares with at least 25% of their TNA held by Investment funds; (iii) the black dotted line traces the evolution of the daily average cumulative flows of fund-shares with at least 25% of their TNA held by Insurance corporations and (iv) the long dashed red line depicts the daily average cumulative flows of SC held by at least 25% by Foreign investors. The vertical grey dotted lines depict two key events: 1) the onset of runs in late February 2020 and 2) the end of runs following large-scale interventions of the European Central Bank (the ECB pandemic purchases were announced on March 18, 2020 and started being implemented as of March 26, 2020). Source: Securities Holdings Statistics aggregated by Sector (SHSS), Lipper Refinitiv, and authors' calculations.

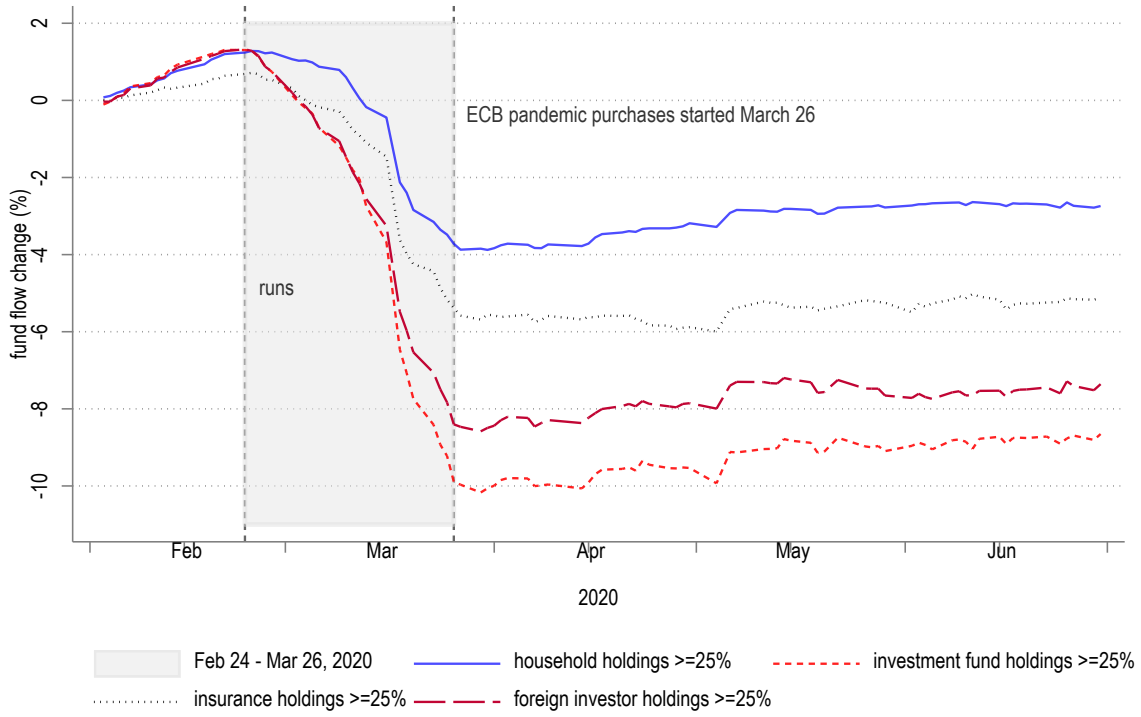

FIGURE 3 – FUND PERFORMANCE BY INVESTOR TYPE

This figure gives the evolution before and after the initial COVID-19 shock of March 2020 of daily average fund performance of fund share-classes after splitting them into 4 groups, depending on their investor base in 2019-Q4. (i) The blue line depicts performance of fund-shares with at least 25% of their TNA held by Households; (ii) the red dotted line gives the performance of fund-shares with at least 25% of their TNA held by Investment funds; (iii) the black dotted line traces the evolution of the performance of fund-shares with at least 25% of their TNA held by Insurance corporations and (iv) the long dashed red line depicts the performance of fund-shares held by at least 25% by Foreign investors. The vertical grey dotted lines depict two key events: 1) the onset of runs in late February 2020 and 2) the end of runs following large-scale interventions of the European Central Bank (the ECB pandemic purchases were announced on March 18, 2020 and started being implemented as of March 26, 2020). Source: Securities Holdings Statistics aggregated by Sector (SHSS), Lipper Refinitiv, and authors' calculations.

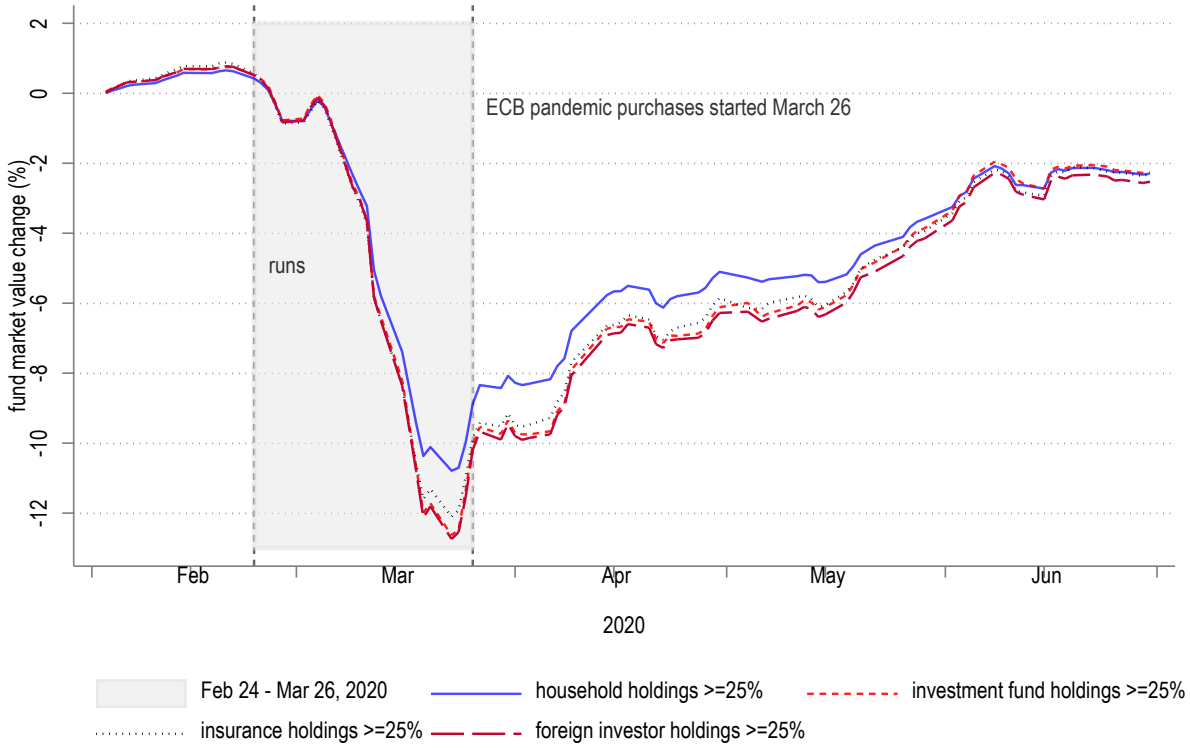

FIGURE 4 – DIFFERENTIAL IMPACT BY INVESTOR TYPE

This figure presents the differential in fund flows for each of the four biggest shareholder types compared to the other investor types. The four biggest shareholders of bond mutual funds in our sample are Investment funds, Households, Foreign investors and Insurance corporations. The differential is in percentage points. We use the following regression set-up

$$\Delta flows_{\mathrm{i,t}} = \beta_0 + \sum_{k=1}^{T} \beta_k \; I_{\,k,t} \times InvestorType_i + \sum_{k=1}^{T} \varphi_k \; I_{\,k,t} \; + \mu_{fund,t} \; + \varepsilon_{i,t}$$

where $\Delta flows_{i,t}$ stands for the cumulative daily fund-share flow of fund-share i at time t (difference to February 3, 2020). The dummy variables $I_{\,k,t}$ take on the value of 1 for period k and zero otherwise. We consider both daily periods and weekly periods over the sample horizon. The variable $InvestorType_i$ is equal to 1 if a fund-share i is held by a specific investor type relatively more, e.g., above-the-median holding amounts or above 25% ownership in the fund share. Lastly, $\mu_{fund,t}$ are fund fixed effects times calendar date fixed effects that allow us to compare different fund shares within the same fund. $\varepsilon_{i,t}$ is the error ter. Source: Securities Holdings Statistics aggregated by Sector (SHSS), Lipper Refinitiv, and authors' calculations.

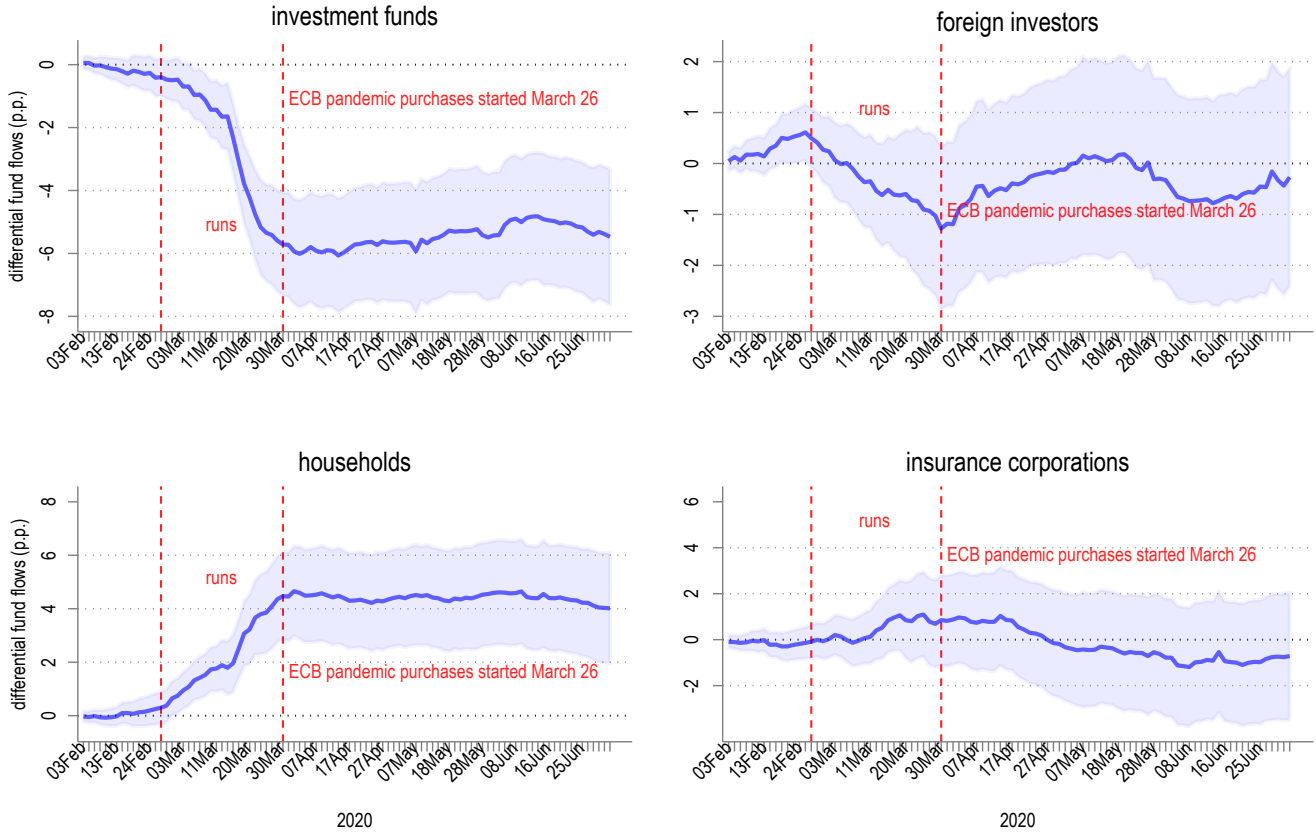

TABLE 1 – SUMMARY STATISTICS: FUND OWNERSHIP

This table shows the distribution of holdings, at the fund-share level, in our sample across investor types. The statistics (means and standard deviations) are reported for the holding volumes (in EUR mil.) as well as holding shares (in % of total fund-share TNA), and are calculated based on 2019-Q4 values. Investor types are split according to the 2010 European System of Accounts, in which eleven groups are defined: Households, Banks (a simplified name for Deposit-taking corporations), Government, Insurance corporations, Pension funds, Investment funds, Other financial intermediaries - the sum of Financial auxiliaries, Captive financial institutions and money lenders, and Other financial intermediaries -, Money market funds, Non-financial corporations, Other euro area investors which groups all euro area investors not previously included, and Foreign investors - computed as the difference between the fund-share TNA and the aggregate euro area holdings of investors reported in the data. Panel A corresponds to all fund-share classes in our sample in which the aggregate euro area holdings of a given fund-share represent at least 50% of fund-share TNA in 2019-Q4. Source: Securities Holdings Statistics aggregated by Sector (SHSS), Lipper Refinitiv, and authors' calculations.

PANEL A

	holdings volume (mil.)			**holdings share (%)**		
	mean	sd	N	mean	sd	N
Households	30.2	88.9	1,593	24.5	30.3	1,593
Banks	1.1	10.6	1,593	0.6	5.1	1,593
Government	3.5	18.4	1,593	2.3	11.1	1,593
Insurance corporations	17.7	61.7	1,593	12.5	23.7	1,593
Pension funds	3.1	14.3	1,593	2.4	10.9	1,593
Investment funds	40.2	99.5	1,593	27.9	34.6	1,593
Other financial intermediaries	1.3	8.1	1,593	1.0	4.9	1,593
Other EA investors	0.1	1.8	1,593	0.1	0.5	1,593
Money market funds	0.0	0.2	1,593	0.0	0.1	1,593
Non-financial corporations	4.3	20.5	1,593	3.2	8.2	1,593
Foreign investors	35.8	87.7	1,593	25.6	20.2	1,593

TABLE 2 – SUMMARY STATISTICS: EXPENSE RATIO

This table links the expense ratio to the underlying ownership base. It presents the distribution of investor types in the lower (below median) and higher (above median) expense ratio bins, as well as the differential between the two means for each investor type (last column). Investor types are as defined in Table 1. While Investment funds are more represented in the below median expense ratio bin compared to the above median expense ratio bin, the opposite is the case for Households. Source: Securities Holdings Statistics aggregated by Sector (SHSS), Lipper Refinitiv, and authors' calculations.

	below median expense ratio			**above median expense ratio**			**diff**
	mean	sd	N	mean	sd	N	
Investment funds	40.1	36.3	720	14.4	26.0	724	25.7
Pension funds	2.9	11.8	720	1.3	7.4	724	1.6
Government	3.0	12.7	720	1.4	7.9	724	1.5
Insurance corporations	12.8	24.7	720	11.7	21.9	724	1.0
Banks	0.9	6.9	720	0.5	3.2	724	0.4
Non-financial corporations	3.4	10.0	720	3.3	6.4	724	0.1
Other EA investors	0.1	0.6	720	0.0	0.3	724	0.0
Money market funds	0.0	0.2	720	0.0	0.0	724	0.0
Other financial intermediaries	0.9	4.7	720	1.1	4.6	724	-0.2
Foreign investors	22.1	18.8	720	29.8	20.7	724	-7.7
Households	13.9	24.2	720	36.5	31.8	724	-22.5

TABLE 3 – FUND FLOWS: SPLIT BY ELASTIC VS INELASTIC INVESTORS

This table presents results for the fund-share split based on higher/lower ownership by elastic investors. Elastic investors are: Investment funds, Foreign investors, Banks, Money market funds, and Other financial institutions. The remaining investors are classified as inelastic. We consider two definitions of the cut-off for being placed into higher versus lower bin, one based on the median elastic ownership value across all fund shares in our sample (columns 1-3) and another based on the relative ranking of ownership within the same fund (columns 4-7). We use the following regression set-up:

$$\Delta flows_{\mathrm{i,t}} = \beta_0 + \sum_{k=1}^{T} \beta_k \; I_{k,t} \times InvestorType_i + \sum_{k=1}^{T} \varphi_k \; I_{k,t} + \mu_{fund} + \varepsilon_{i,t}$$

where $\Delta flows_{i,t}$ stands for the cumulative daily fund-share flow of fund-share i at time t (difference to February 3, 2020). The dummy variables $I_{k,t}$ take on the value of 1 for period k and zero otherwise. We consider both daily periods and weekly periods over the sample horizon. The variable $InvestorType_i$ is equal to 1 if a fund-share i is held by a specific investor type relatively more, e.g., above-the-median holding amounts or above 25% ownership in the fund share. Lastly, μ_{fund} are fund fixed effects that allow us to compare different fund shares within the same fund. $\varepsilon_{i,t}$ is the error term. ***, **, * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	median split			relative split			
fund flow change (%)	inelastic	elastic	diff	inelastic	elastic	diff	diff rel. >= 25 %
week [Feb 20 - Feb 26] * elastic inv. dummy	-	-	0.138	-	-	-0.039	-0.032
			(0.316)			(0.372)	(0.459)
week [Feb 27 - Mar 04] * elastic inv. dummy	-	-	**-0.903*** **	-	-	**-0.757** **	**-1.030** **
			(0.316)			(0.372)	(0.459)
week [Mar 05 - Mar 11] * elastic inv. dummy	-	-	**-2.168*** **	-	-	**-1.461*** **	**-1.932*** **
			(0.316)			(0.372)	(0.459)
week [Mar 12 - Mar 18] * elastic inv. dummy	-	-	**-3.702*** **	-	-	**-2.177*** **	**-3.053*** **
			(0.343)			(0.404)	(0.498)
week [Mar 19 - Mar 25] * elastic inv. dummy	-	-	**-5.903*** **	-	-	**-3.476*** **	**-5.131*** **
			(0.316)			(0.372)	(0.459)
week [Mar 26 - Apr 01] * elastic inv. dummy	-	-	**-7.046*** **	-	-	**-4.020*** **	**-5.808*** **
			(0.316)			(0.372)	(0.459)
week [Apr 02 - Apr 08] * elastic inv. dummy	-	-	**-6.918*** **	-	-	**-3.680*** **	**-5.395*** **
			(0.316)			(0.372)	(0.459)
week [Apr 09 - Jun 30] * elastic inv. dummy	-	-	**-6.881*** **	-	-	**-3.310*** **	**-5.147*** **
			(0.191)			(0.225)	(0.277)
week [Feb 20 - Feb 26]	0.606***	0.743***	0.606***	0.585***	0.545***	0.584**	0.640*
	(0.170)	(0.230)	(0.227)	(0.189)	(0.199)	(0.268)	(0.331)
week [Feb 27 - Mar 04]	0.516***	-0.387*	0.516**	0.418**	-0.338*	0.418	0.574*
	(0.170)	(0.229)	(0.227)	(0.189)	(0.199)	(0.267)	(0.331)
week [Mar 05 - Mar 11]	0.201	-1.960***	0.205	-0.070	-1.530***	-0.069	0.127
	(0.170)	(0.230)	(0.227)	(0.189)	(0.199)	(0.268)	(0.331)
week [Mar 12 - Mar 18]	-0.925***	-4.626***	-0.925***	-1.384***	-3.557***	-1.382***	-1.075***
	(0.184)	(0.249)	(0.246)	(0.205)	(0.216)	(0.290)	(0.359)
week [Mar 19 - Mar 25]	-3.041***	-8.941***	-3.040***	-3.679***	-7.155***	-3.679***	-3.176***
	(0.170)	(0.230)	(0.227)	(0.189)	(0.199)	(0.268)	(0.331)
week [Mar 26 - Apr 01]	-3.670***	-10.716***	-3.670***	-4.613***	-8.622***	-4.607***	-4.146***
	(0.170)	(0.230)	(0.227)	(0.189)	(0.199)	(0.268)	(0.331)
week [Apr 02 - Apr 08]	-3.678***	-10.594***	-3.677***	-4.715***	-8.425***	-4.732***	-4.333***
	(0.170)	(0.230)	(0.227)	(0.189)	(0.199)	(0.268)	(0.331)
week [Apr 09 - Jun 30]	-2.930***	-9.807***	-2.928***	-4.261***	-7.557***	-4.254***	-3.727***
	(0.103)	(0.139)	(0.137)	(0.114)	(0.120)	(0.162)	(0.200)
Observations	74,147	78,353	152,500	47,095	50,354	97,449	67,378
R-squared	0.5047	0.4315	0.3629	0.7117	0.6708	0.4336	0.4398
-	-	-	-	-	-	-	-
fund FE	YES	YES	YES	YES	YES	YES	YES

TABLE 4 – FUND FLOWS: SPLIT BY SOPHISTICATED VS UNSOPHISTICATED INVESTORS

This table presents results for the fund-share split based on higher/lower expense ratios, with lower expense ratio associated with ownership by sophisticated investors and vice versa. Two definitions of the cut-off for being placed into higher versus lower bin are considered: one based on the median value for the expense ratio across all fund shares (columns 1-3) and another based on the relative value for the expense ratio within the same fund (columns 4-7). We use the following regression set-up:

$$\Delta flows_{\mathrm{i,t}} = \beta_0 + \sum_{k=1}^{T} \beta_k \; I_{k,t} \times InvestorType_i + \sum_{k=1}^{T} \varphi_k \; I_{k,t} + \mu_{fund} + \varepsilon_{i,t}$$

where $\Delta flows_{i,t}$ stands for the cumulative daily fund-share flow of fund-share i at time t (difference to February 3, 2020). The dummy variables $I_{k,t}$ take on the value of 1 for period k and zero otherwise. We consider both daily periods and weekly periods over the sample horizon. The variable $InvestorType_i$ is equal to 1 if a fund-share i is held by a specific investor type relatively more, e.g., above-the-median holding amounts or above 25% ownership in the fund share. Lastly, μ_{fund} are fund fixed effects that allow us to compare different fund shares within the same fund. $\varepsilon_{i,t}$ is the error term. ***, **, * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	median split			relative split			
fund flow change (%)	unsophisti-cated	sophisticated	diff	unsophisti-cated	sophisticated	diff	diff rel. >= .5
week [Feb 20 - Feb 26] * soph. inv. dummy	-	-	-0.121	-	-	-0.081	0.149
			(0.452)			(0.516)	(0.549)
week [Feb 27 - Mar 04] * soph. inv. dummy	-	-	-0.247	-	-	-0.773	-0.546
			(0.452)			(0.516)	(0.549)
week [Mar 05 - Mar 11] * soph. inv. dummy	-	-	-0.604	-	-	**-1.737*** **	**-1.734*** **
			(0.453)			(0.517)	(0.550)
week [Mar 12 - Mar 18] * soph. inv. dummy	-	-	**-1.390*** **	-	-	**-2.461*** **	**-2.596*** **
			(0.490)			(0.560)	(0.595)
week [Mar 19 - Mar 25] * soph. inv. dummy	-	-	**-2.285*** **	-	-	**-3.791*** **	**-4.166*** **
			(0.452)			(0.516)	(0.549)
week [Mar 26 - Apr 01] * soph. inv. dummy	-	-	**-2.629*** **	-	-	**-4.474*** **	**-5.120*** **
			(0.452)			(0.516)	(0.549)
week [Apr 02 - Apr 08] * soph. inv. dummy	-	-	**-2.357*** **	-	-	**-4.190*** **	**-4.864*** **
			(0.453)			(0.517)	(0.550)
week [Apr 09 - Jun 30] * soph. inv. dummy	-	-	**-1.352*** **	-	-	**-3.952*** **	**-5.120*** **
			(0.273)			(0.312)	(0.331)
week [Feb 20 - Feb 26]	0.521*	0.412	0.527	0.486**	0.416	0.491	0.502
	(0.272)	(0.305)	(0.321)	(0.225)	(0.330)	(0.365)	(0.359)
week [Feb 27 - Mar 04]	-0.114	-0.369	-0.118	0.225	-0.555*	0.222	0.224
	(0.271)	(0.305)	(0.321)	(0.225)	(0.330)	(0.364)	(0.359)
week [Mar 05 - Mar 11]	-1.030***	-1.643***	-1.034***	-0.313	-2.055***	-0.315	-0.342
	(0.272)	(0.305)	(0.321)	(0.225)	(0.330)	(0.365)	(0.359)
week [Mar 12 - Mar 18]	-2.559***	-3.951***	-2.560***	-1.719***	-4.172***	-1.715***	-1.771***
	(0.295)	(0.331)	(0.348)	(0.244)	(0.358)	(0.396)	(0.390)
week [Mar 19 - Mar 25]	-5.538***	-7.806***	-5.530***	-4.398***	-8.169***	-4.388***	-4.387***
	(0.272)	(0.305)	(0.321)	(0.225)	(0.330)	(0.365)	(0.359)
week [Mar 26 - Apr 01]	-6.597***	-9.213***	-6.590***	-5.251***	-9.714***	-5.246***	-5.239***
	(0.272)	(0.305)	(0.321)	(0.225)	(0.330)	(0.365)	(0.359)
week [Apr 02 - Apr 08]	-6.609***	-8.993***	-6.625***	-5.252***	-9.464***	-5.263***	-5.229***
	(0.272)	(0.305)	(0.322)	(0.225)	(0.330)	(0.365)	(0.360)
week [Apr 09 - Jun 30]	-6.212***	-7.559***	-6.210***	-4.481***	-8.423***	-4.475***	-4.455***
	(0.164)	(0.184)	(0.194)	(0.136)	(0.199)	(0.220)	(0.217)
Observations	34,165	34,764	68,929	21,161	21,052	42,213	35,989
R-squared	0.4625	0.4086	0.3058	0.6501	0.6231	0.3881	0.4257
-	-	-	-	-	-	-	-
fund FE	YES	YES	YES	YES	YES	YES	YES

TABLE 5 – FUND FLOWS: SPLIT BY INVESTOR TYPE

This table focuses on the largest shareholders of funds - Investment funds (columns 1 - 2), Households (columns 3 - 4), Insurance corporations (columns 5 – 6), and Foreign investors (columns 7 – 8). Each fund share is placed in one of the two bins: higher/lower than 25% ownership by investor type X where X is one of the four afore-mentioned investor groups. We use the following regression set-up

$$\Delta flows_{\mathrm{i,t}} = \beta_0 + \sum_{k=1}^{T} \beta_k \; I_{k,t} \times InvestorType_i + \sum_{k=1}^{T} \varphi_k \; I_{k,t} + \mu_{fund} + \varepsilon_{i,t}$$

where $\Delta flows_{i,t}$ stands for the cumulative daily fund-share flow of fund-share i at time t (difference to February 3, 2020). The dummy variables $I_{k,t}$ take on the value of 1 for period k and zero otherwise. We consider both daily periods and weekly periods over the sample horizon. The variable $InvestorType_i$ is equal to 1 if a fund-share i is held by a specific investor type relatively more, e.g., above-the-median holding amounts or above 25% ownership in the fund share. Lastly, μ_{fund} are fund fixed effects that allow us to compare different fund shares within the same fund. $\varepsilon_{i,t}$ is the error term. ***, **, * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	investment funds		households		insurance corporations		foreign investors	
fund flow change (%)	>= 25 %	diff	>= 25 %	diff	>= 25 %	diff	>= 25 %	diff
week [Feb 20 - Feb 26] * holding dummy (>= 25 %)	-	0.095	-	0.076	-	-0.287	-	0.146
		(0.325)		(0.331)		(0.426)		(0.323)
week [Feb 27 - Mar 04] * holding dummy (>= 25 %)	-	-0.449	-	**0.897*** **	-	0.025	-	-0.373
		(0.325)		(0.331)		(0.425)		(0.323)
week [Mar 05 - Mar 11] * holding dummy (>= 25 %)	-	**-1.190*** **	-	**1.771*** **	-	0.379	-	**-1.233*** **
		(0.325)		(0.332)		(0.426)		(0.323)
week [Mar 12 - Mar 18] * holding dummy (>= 25 %)	-	**-2.348*** **	-	**2.614*** **	-	**1.002** **	-	**-1.852*** **
		(0.352)		(0.359)		(0.462)		(0.350)
week [Mar 19 - Mar 25] * holding dummy (>= 25 %)	-	**-4.513*** **	-	**3.980*** **	-	**1.584*** **	-	**-2.533*** **
		(0.325)		(0.332)		(0.426)		(0.323)
week [Mar 26 - Apr 01] * holding dummy (>= 25 %)	-	**-5.377*** **	-	**4.677*** **	-	**1.828*** **	-	**-3.046*** **
		(0.325)		(0.332)		(0.426)		(0.323)
week [Apr 02 - Apr 08] * holding dummy (>= 25 %)	-	**-5.285*** **	-	**4.639*** **	-	**1.646*** **	-	**-2.891*** **
		(0.325)		(0.332)		(0.426)		(0.323)
week [Apr 09 - Jun 30] * holding dummy (>= 25 %)	-	**-5.255*** **	-	**4.733*** **	-	**1.024*** **	-	**-3.019*** **
		(0.196)		(0.200)		(0.257)		(0.195)
week [Feb 20 - Feb 26]	0.738***	0.641***	0.724***	0.651***	0.440	0.728***	0.759***	0.612***
	(0.262)	(0.204)	(0.184)	(0.200)	(0.288)	(0.177)	(0.224)	(0.217)
week [Feb 27 - Mar 04]	-0.219	0.233	0.626***	-0.272	0.075	0.050	-0.151	0.222
	(0.262)	(0.204)	(0.184)	(0.200)	(0.288)	(0.177)	(0.224)	(0.216)
week [Mar 05 - Mar 11]	-1.618***	-0.436**	0.209	-1.554***	-0.595**	-0.973***	-1.588***	-0.354
	(0.262)	(0.204)	(0.184)	(0.200)	(0.288)	(0.177)	(0.224)	(0.217)
week [Mar 12 - Mar 18]	-4.243***	-1.896***	-1.166***	-3.778***	-1.996***	-2.998***	-3.845***	-1.993***
	(0.284)	(0.222)	(0.199)	(0.217)	(0.312)	(0.192)	(0.243)	(0.235)
week [Mar 19 - Mar 25]	-8.796***	-4.287***	-3.548***	-7.523***	-4.762***	-6.345***	-7.467***	-4.934***
	(0.262)	(0.204)	(0.184)	(0.200)	(0.288)	(0.177)	(0.224)	(0.217)
week [Mar 26 - Apr 01]	-10.539***	-5.165***	-4.317***	-8.996***	-5.777***	-7.607***	-8.968***	-5.922***
	(0.262)	(0.204)	(0.184)	(0.200)	(0.288)	(0.177)	(0.224)	(0.217)
week [Apr 02 - Apr 08]	-10.415***	-5.139***	-4.289***	-8.920***	-5.861***	-7.512***	-8.821***	-5.929***
	(0.262)	(0.204)	(0.184)	(0.200)	(0.288)	(0.177)	(0.224)	(0.217)
week [Apr 09 - Jun 30]	-9.637***	-4.384***	-3.458***	-8.189***	-5.619***	-6.639***	-8.127***	-5.106***
	(0.158)	(0.123)	(0.111)	(0.121)	(0.174)	(0.107)	(0.135)	(0.131)
Observations	60,262	152,500	55,634	152,500	26,356	152,500	68,500	152,500
R-squared	0.4527	0.3559	0.6057	0.3505	0.5820	0.3397	0.4587	0.3412
-	-	-	-	-	-	-	-	-
fund FE	YES	YES	YES	YES	YES	YES	YES	YES

TABLE 6 – FUND FLOWS: SPLIT BY INVESTOR TYPE, FUND-TIME FIXED EFFECTS

This table focuses on the largest shareholders of funds - Investment funds (columns 1 - 2), Households (columns 3 - 4), Insurance corporations (columns 5 – 6), and Foreign investors (columns 7 – 8). Each fund share is placed in one of the two bins: higher/lower than 25% ownership by investor type X where X is one of the four afore-mentioned investor groups. We use the following regression set-up

$$\Delta flows_{\mathrm{i,t}} = \beta_0 + \sum_{k=1}^{T} \beta_k \; I_{\,k,t} \times InvestorType_i + \sum_{k=1}^{T} \varphi_k \; I_{\,k,t} \; + \mu_{fund,t} \; + \varepsilon_{i,t}$$

where $\Delta flows_{i,t}$ stands for the cumulative daily fund-share flow of fund-share i at time t (difference to February 3, 2020). The dummy variables $I_{\,k,t}$ take on the value of 1 for period k and zero otherwise. We consider both daily periods and weekly periods over the sample horizon. The variable $InvestorType_i$ is equal to 1 if a fund-share i is held by a specific investor type relatively more, e.g., above-the-median holding amounts or above 25% ownership in the fund share. Lastly, $\mu_{fund,t}$ are fund fixed effects times calendar date fixed effects that allow us to compare different fund shares within the same fund. $\varepsilon_{i,t}$ is the error term. ***, **, * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)
fund flow change (%)	investment funds	households	insurance corporations	foreign investors
week [Feb 20 - Feb 26] * holding dummy (>= 25 %)	-0.268	0.247	0.007	0.310
	(0.474)	(0.474)	(0.607)	(0.486)
week [Feb 27 - Mar 04] * holding dummy (>= 25 %)	-0.564	**0.941****	0.193	-0.097
	(0.473)	(0.473)	(0.607)	(0.486)
week [Mar 05 - Mar 11] * holding dummy (>= 25 %)	**-1.220****	**1.659*****	0.217	-0.532
	(0.474)	(0.474)	(0.607)	(0.486)
week [Mar 12 - Mar 18] * holding dummy (>= 25 %)	**-2.892*****	**2.498*****	0.978	**-0.805***
	(0.476)	(0.475)	(0.609)	(0.489)
week [Mar 19 - Mar 25] * holding dummy (>= 25 %)	**-5.155*****	**3.948*****	**1.014***	**-1.073****
	(0.474)	(0.474)	(0.607)	(0.486)
week [Mar 26 - Apr 01] * holding dummy (>= 25 %)	**-5.762*****	**4.527*****	**1.023***	**-1.281*****
	(0.474)	(0.474)	(0.607)	(0.486)
week [Apr 02 - Apr 08] * holding dummy (>= 25 %)	**-5.799*****	**4.498*****	0.912	-0.764
	(0.474)	(0.474)	(0.607)	(0.486)
week [Apr 09 - Jun 30] * holding dummy (>= 25 %)	**-5.274*****	**4.377*****	-0.349	**-0.523***
	(0.286)	(0.286)	(0.366)	(0.294)
Observations	153,114	153,114	153,114	153,114
R-squared	0.4678	0.4632	0.4543	0.4543
-	-	-	-	-
fund FE x date FE	YES	YES	YES	YES