EUROPEAN CENTRAL BANK

EUROSYSTEM

Mutual fund fragility: The role of investor base and lender of last resort interventions

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The views expressed are solely those of the authors.

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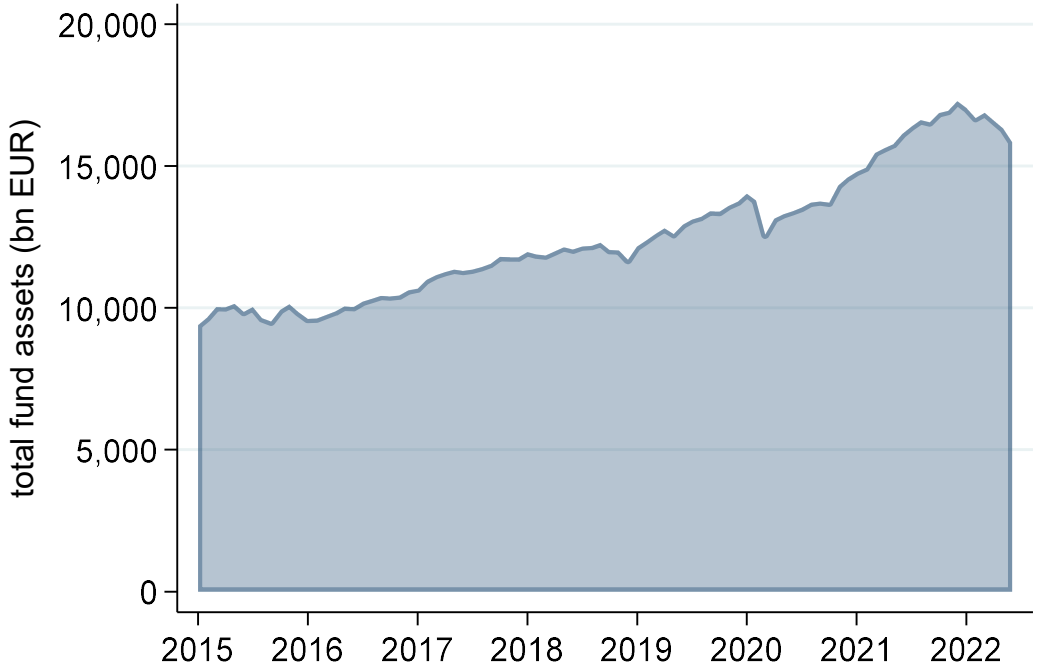
Mutual fund sector in the euro area (EA)



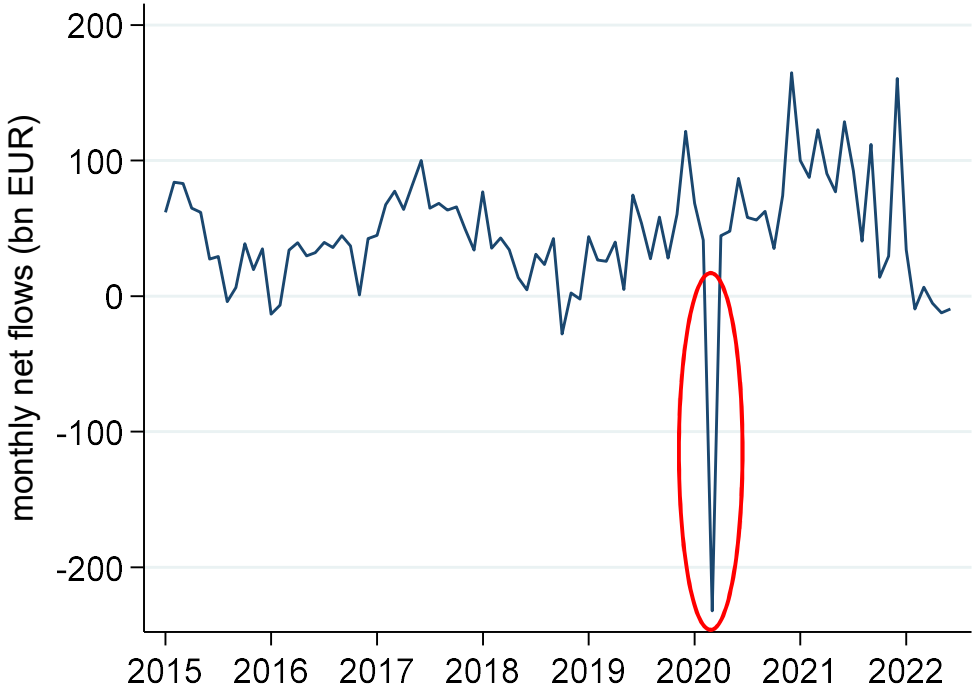
Doubled in size since 2014, €16 tn in assets in 2023

For comparison: EA banking sector assets €38 tn in 2023

Funds are major holders of securities in the EA

Note: EA aggregate mutual fund assets (EUR bn). Monthly data, 2015-2022.
Source: Investment Funds Balance Sheet Statistics.

Mutual fund fragility: March 2020 large-scale run



Unprecedented redemptions, largely from **bond** funds (€150 bn)

Large outflows also in US bond mutual funds (Falato, Goldstein, Hortaçsu, 2021)

Mutual funds → largest net sellers of securities in EA in Q1 2020 (> €250 bn) (spillovers to broader financial markets)

Note: Net issues in the EA mutual fund sector (EUR bn).
Monthly data, 2015-2022.
Source: Investment Funds Balance Sheet Statistics.

Research questions

1. Who runs on mutual funds?

- liquidity transformation → vulnerable to investor runs (Chen, Goldstein, Jiang, 2010)
- does fund investor base matter for fragility? are all investors created equal?
- based on "Fund fragility: The role of investor base" by Allaire, Breckenfelder and Hoerova (2022)

2. Do non-banks need access to the lender of last resort (LOLR)?

- analyse March 2020 crisis to assess the impact of central bank asset purchases (PEPP) as well as central bank liquidity provision to *banks* ("Bridge" LTROs)
- based on "Do non-banks need access to the lender of last resort? Evidence from fund runs" by Breckenfelder and Hoerova (2021)

Summary take-aways

1. Who runs on mutual funds? Other funds do!

- fund-shares with higher ownership by **other funds** faced much higher outflows (by 6 p.p) compared to the other fund-shares within the same fund, on the same day
- fund-shares with higher ownership by **HHs** had much lower outflows (by 5 p.p.)

→ liquidity regulation for funds should incorporate the role of a fund's investor base

2. Do non-banks need access to the lender of last resort (LOLR)?

- asset purchases (aka market maker of last resort interventions) very effective: fund performance improved upon announcement, outflows stabilised quickly
- central bank liquidity provision to *banks* supported bank repo lending to *funds*

→ applying the *existing* toolkit during March 2020 crisis helped funds

Outline

Who runs on mutual funds?

1. Data sources
2. Who holds mutual funds?
3. Who runs on mutual funds?
4. Implications for policy

Do non-banks need access to the lender of last resort (LOLR)?

5. Central bank asset purchases: Impact on funds
6. Central bank liquidity provision to *banks*: Impact on funds
7. Policy implications

1

Data sources

Data: Combining SHSS and Lipper information

Two main data sources:

- Securities Holdings Database by Sector (SHSS): quarterly investor base
- Refinitiv's Lipper for Investment Fund Management: daily flows, Jan – Jun 2020
- Merged SHSS-Lipper sample: security-level panel of bond mutual fund-shares

Fund ownership measured on the fund-share level in 2019-Q4

Focus on funds that satisfy 2 criteria:

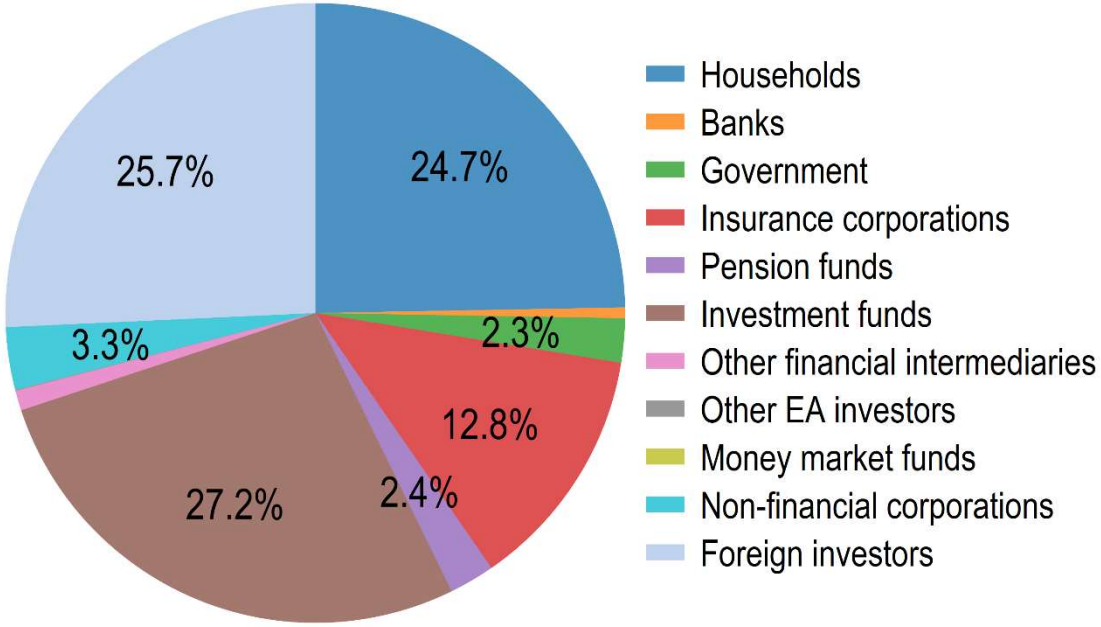
1. EA ownership of a fund share at least 50% of TNA
2. at least two such fund-shares per fund (to hold fund portfolio fixed and exploit variation across fund-shares of the same fund)

[details]

2

Who holds bond mutual funds?

Summary statistics: Fund ownership (average fund)



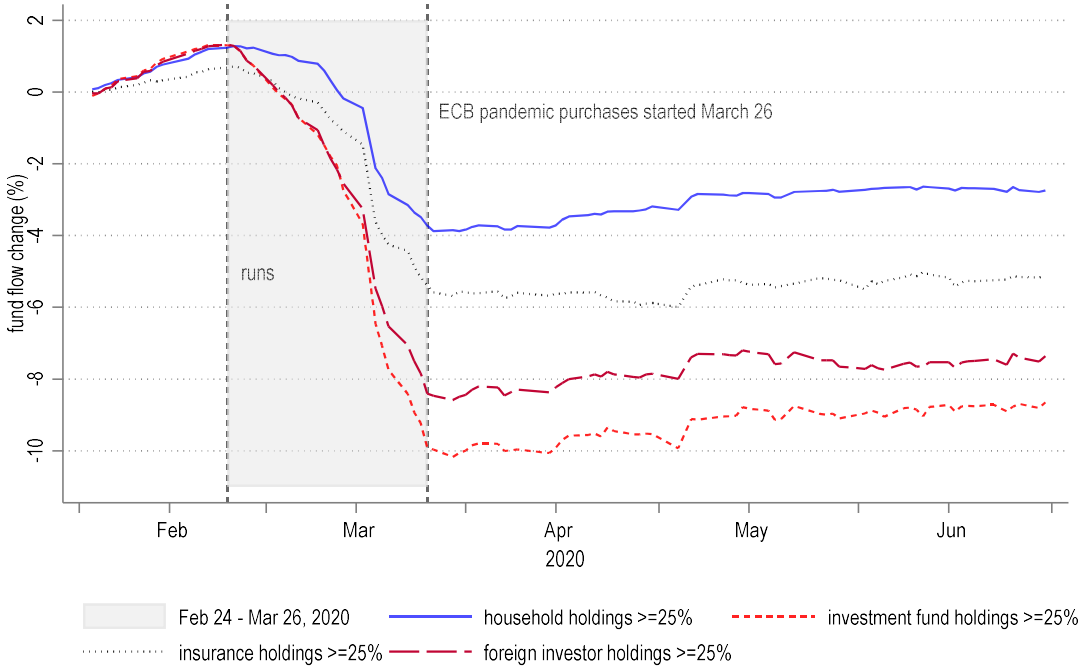
4 largest shareholder types:

- Investment funds: 27.2%
- Foreign sector: 25.7%
- HHs: 24.7%
- Insurance companies: 12.8%

The remaining investors account for less than 10% of holdings

[stats] [aggregate]

Fund flows across 4 main shareholder types



4 main shareholder types:

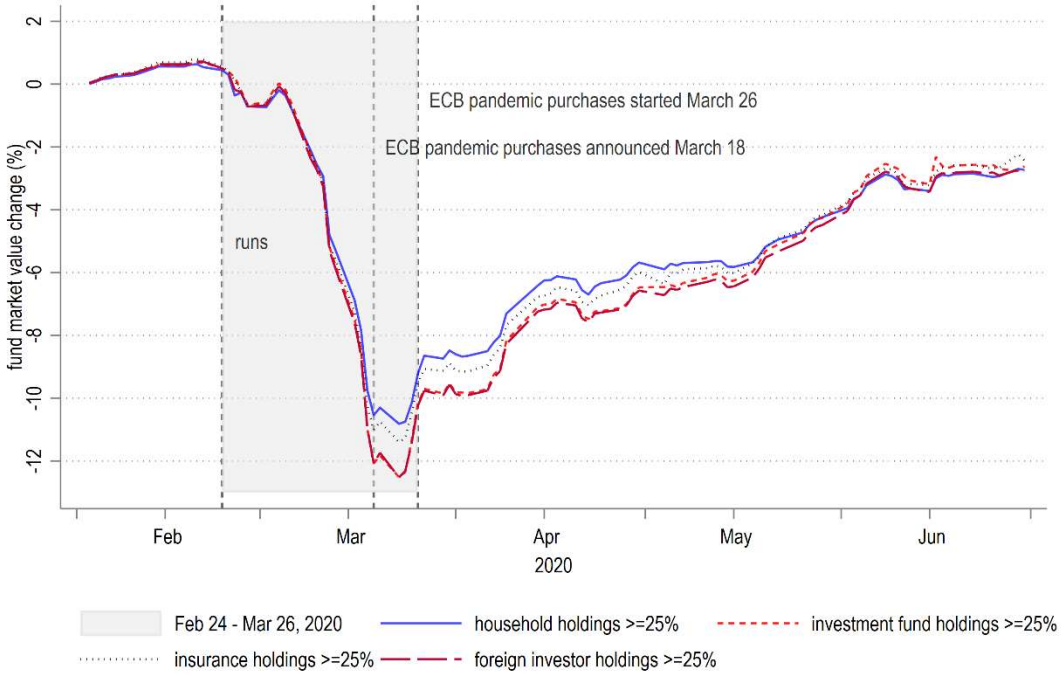
- Investment funds, HHs, Insurance corporations, Foreign investors

Ownership cutoff is 25% in total:

- any fund share in which Investment funds hold at least 25% assigned to a group “Investment funds ≥ 25%” etc.

Note: Sum of daily net flows, February – June 2020;
$flows_{\mathrm{i,t}} = (TNA_{\mathrm{i,t}} - (1 + \mathrm{r_{i,t}}) * TNA_{i,t-1}) / TNA_{i,t-1}$.
Source: Authors’ calculations.

Fund performance across 4 main shareholder types



Before and at the onset of the run, no significant differences in fund performance

On average, fund-shares lost about 12% of their value

- value loss stopped on March 18, 2020, upon announcement of the ECB's pandemic purchase program

Note: Fund performance, February – June 2020.
Source: Authors' calculations.

3

Who runs on bond mutual funds?

Empirical methodology: Two elements

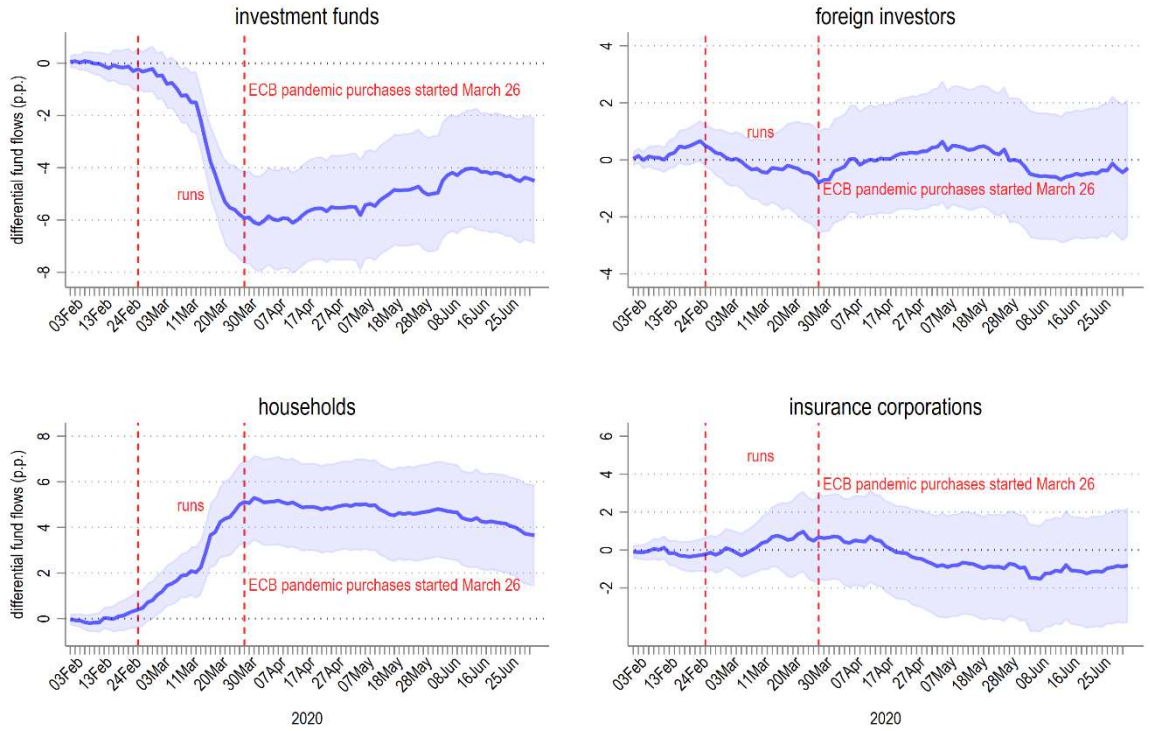
1. Exploit investor base heterogeneity across different fund shares within the *same* fund
   - fund shares within a fund have the *same underlying portfolio*, incl. cash holdings
   - fund shares within a fund have different min investment amounts, fees etc., catering to different investors (e.g., retail vs institutional)

2. Fund shares within the same fund can differ in performance over time
   - bad performance can trigger more outflows
   - want to control for time-varying differences across fund shares within a fund

→ Add calendar date time fixed effects interacted with fund fixed effects

[set-up]

Fund flows: Differential impact by investor type (daily)



Key take-aways graphically:

- no differential in outflows before the run onset
- fund-shares (within same fund) owned by **Funds**: the (-) flow differential amounts to 6 p.p.
- fund-shares (within same fund) owned by **HHs**: the (+) flow differential amounts to 5 p.p.

[table]

Note: Differential fund flows according to investor base.
Source: Refinitiv's Lipper, SHS, authors' calculations.

4 Policy implications

Liquidity regulation for funds: Assets vs liabilities

Recent proposals to regulate liquidity holdings of funds

- e.g., Securities and Exchange Commission, 2022; Dekker, Molestina Vivar, Wedow, Weistroffer, 2023

→ if funds hold illiquid assets, should hold more cash

This paper: focus on the *liability* side → run incentives of different investors

- key insight: holding the liquidity of fund portfolio fixed, fund shares held by other funds are more vulnerable to runs

→ Regulation should incorporate the role of a fund's investor base

- bank liquidity regulation also incorporates depositors' differential propensity to withdraw

5

LOLR access? Impact of central bank asset purchases on funds

Impact of purchases on fund performance and flows

The Pandemic Emergency Purchase Programme (PEPP):

- announced March 18, 2020 (evening), implemented as of March 26, 2020

Focus on bond mutual funds that:

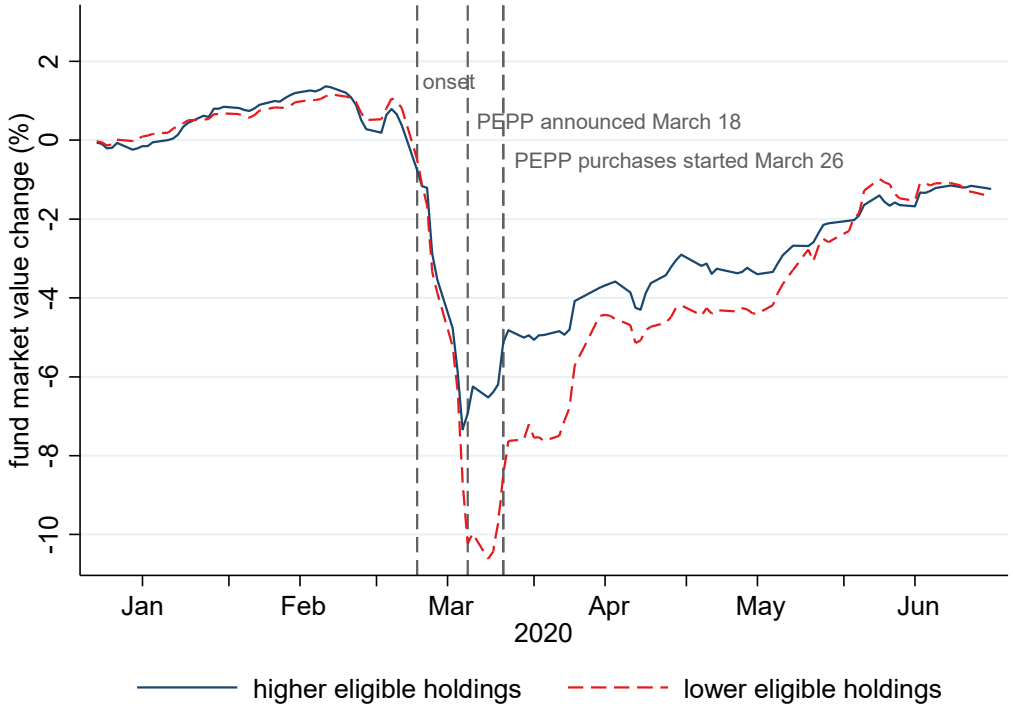
- invest in investment grade securities
- hold a non-zero share of euro area securities in their portfolio

Compare funds with higher shares of PEPP-eligible assets ex ante (Jan 2020) with funds with lower shares:

- difference related to, e.g., holdings of securities issued by US-issuers (15% vs 40% for higher vs lower PEPP-eligible funds) or securities issued by banks

[stats] [diff-in-diff setup]

PEPP impact on fund performance



After PEPP announcement, performance gap between the higher/lower eligible funds (β_k)

- announcement week: 3.7 p.p
- 1st implementation week: 2.7 p.p
- 2nd implementation week: 2.1 p.p.
- thereafter, gap not significant

Note: Evolution of daily average fund performance.
Source: Refinitiv's Lipper, authors' calculations.

PEPP impact on fund net flows

	differential high/low PEPP-eligibility	differential high/low PEPP-eligibility
*crisis onset * eligible bond dummy (> median)*	0.165	0.165
	(0.112)	(0.113)
*PEPP announcement * eligible bond dummy (> median)*	**0.324*** **	**0.325*** **
	(0.106)	(0.107)
*PEPP impl. week 1 * eligible bond dummy (> median)*	0.035	0.034
	(0.036)	(0.036)
*PEPP impl. week 2 * eligible bond dummy (> median)*	0.039	0.040
	(0.040)	(0.040)
*PEPP impl. week 2 plus * eligible bond dummy (> median)*	0.003	0.003
	(0.024)	(0.024)
…	…	…
Δ *USD/EUR exchange rate*		1.019
		(0.741)
Observations	92,568	92,568
R-squared	0.0189	0.0572
Fund Share FE	NO	YES
Clustered Std. Err.	Fund	Fund

After PEPP announcement, net flows of higher PEPP-eligibility funds ↑ by 63% relative to the other funds

By end-March 2020, runs stopped and flows largely stabilized in both groups

Central bank asset purchases: Additional results

We find strong announcement effects → why?

- investigate the role of PEPP flexibility: allowed the ECB to temporarily "tilt" its asset purchases towards some issuers → *within* more PEPP-eligible group, split according to higher/lower-rates countries' exposure
- a significant differential in performance (2.6 p.p. in the announcement week); no differential in outflows (runs attenuated equally in more PEPP-eligible group)

What about Fed interventions?

- double sort on PEPP and Fed eligibility, daily dummies
- PEPP announcement day: differential performance for funds with more PEPP-eligible assets equal to ca. 1.5 p.p.
- the 2nd Fed intervention of April 9 lifted performance of more Fed-eligible group

[graphs]

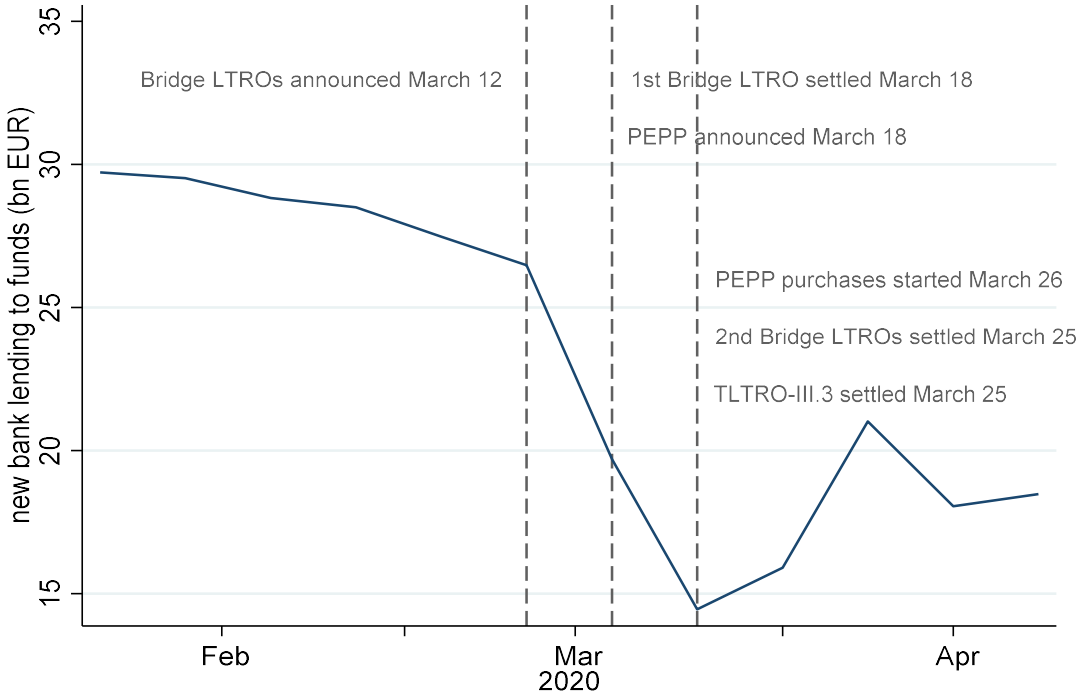
6

LOLR access? Impact of central bank liquidity provision on funds

Banks have LOLR access → can pass on liquidity?

Did they? Look at repos between banks and funds

Bank cash lending to investment funds ↓ 50% bw February and March 2020, from €30 bn to €15 bn a day



Note: Bank cash lending to funds in EA secured markets, new transactions (daily averages over a week, € bn).
Source: MMSR, authors' calculations.

CB liquidity provision and bank repo lending

New Long-Term Refinancing Operations - “Bridge” LTROs:

- announced March 12, 2020; conducted weekly; all matured June 24, 2020

Focus on relationships an investment fund had with banks prior to the crisis:

- bank-fund relationships sticky and do not change over time
- funds with ≥2 relationships, control for fund-specific effects (Khwaja, Mian, 2008)

Compare repo lending across banks with higher / lower exposure to the pandemic-induced liquidity crisis (‘dash for cash’) ex ante (Jan 2020):

- two cross-sectional splits: 1) on commercial paper roll-over; 2) on excess reserves

[stats] [diff-in-diff setup]

CB liquidity provision and bank repo lending

Test how bank repo lending to *investment* funds changed:

1. following the **announcement** of the Bridge LTROs (compared to the previous week)
2. following the **settlement** of the first Bridge LTRO / PEPP announcement (compared to the previous week)

– banks more exposed to March 2020 liquidity crisis should be relatively more affected by the CB liquidity provision

1. **Announcement** of Bridge LTROs:

– **no evidence** of a positive effect on bank repo lending to investment funds, across more/less exposed banks

2. Settlement of 1st Bridge LTRO / PEPP announcement

More exposed banks lend more: growth of repo transactions ↑ 1.4 times (1.6 times) and of amounts outstanding ↑ 1.35 times (1.6 times) for CP (excess reserves) split

	commercial paper split		excess reserves split	
	Δ transaction volumes	Δ amount outstanding	Δ transaction volumes	Δ amount outstanding
exposure dummy	**1.406****	**1.354*****	**1.639***	**1.642*****
	(0.682)	(0.466)	(0.847)	(0.440)
...	...	...	...	...
bank-level controls	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES
Observations	670	670	670	670
R-squared	0.326	0.250	0.33	0.259
Clustered Std. Err.	Bank	Bank	Bank	Bank

2a. 1st Bridge LTRO take-up

More exposed banks that took up 1st Bridge LTRO: growth of repo transactions ↑ 5.5 times (4.2 times) for CP (excess reserves) split

	commercial paper split		excess reserves split	
	Δ transaction volumes	Δ amount outstanding	Δ transaction volumes	Δ amount outstanding
exposure dummy x LTRO take-up dummy	**5.517****	2.135	**4.189****	0.947
	(2.439)	(1.780)	(1.589)	(1.249)
…	…	…	…	…
bank-level controls	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES
Observations	670	670	670	670
R-squared	0.341	0.254	0.345	0.260
Clustered Std. Err.	Bank	Bank	Bank	Bank

7

Policy implications

Do non-banks need access to the LOLR?

Funds as eligible CB counterparties? New dedicated credit facility for funds? Fund shares eligible for CB purchases or as collateral?

- granting funds access to LOLR has costs: operational challenges, additional risks

This paper: Applying the *existing* toolkit during March 2020 crisis helped

- asset purchases (aka market maker of last resort interventions) very effective: fund performance improved upon announcement, outflows stabilised quickly
- central bank liquidity provision to *banks* supported bank repo lending to *funds*

→ Input into a cost-benefit analysis of granting funds access to LOLR

THANK YOU!

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Summary statistics: Fund ownership (aggregate)

PANEL A

	holdings volume (mil.)	holdings share (%)
Households	51,196.32	21.91
Banks	1,754.57	0.75
Government	6,010.76	2.57
Insurance corporations	32,108.19	13.74
Pension funds	5,412.60	2.32
Investment funds	67,414.53	28.85
Other financial intermediaries	2,180.78	0.93
Other EA investors	202.66	0.09
Money market funds	11.87	0.01
Non-financial corporations	7,295.15	3.12
Foreign investors	60,080.49	25.71

Final sample: 545 distinct bond mutual funds and 1,737 fund shares

Assets under management of €370 bn in 2019-Q4

[back]

Summary statistics: Fund ownership (average fund)

PANEL A

	holdings volume (mil.)			holdings share (%)		
	mean	sd	N	mean	sd	N
Households	29.47	88.15	1,737	24.71	30.05	1,737
Banks	1.01	10.12	1,737	0.56	4.89	1,737
Government	3.46	18	1,737	2.3	11.31	1,737
Insurance corporations	18.48	77.28	1,737	12.8	23.77	1,737
Pension funds	3.12	14.2	1,737	2.37	10.81	1,737
Investment funds	38.81	98.4	1,737	27.17	34.39	1,737
Other financial intermediaries	1.26	7.79	1,737	1.04	4.8	1,737
Other EA investors	0.12	2.21	1,737	0.05	0.46	1,737
Money market funds	0.01	0.2	1,737	0	0.12	1,737
Non-financial corporations	4.2	20.13	1,737	3.26	8.21	1,737
Foreign investors	34.59	85.64	1,737	25.73	20.04	1,737

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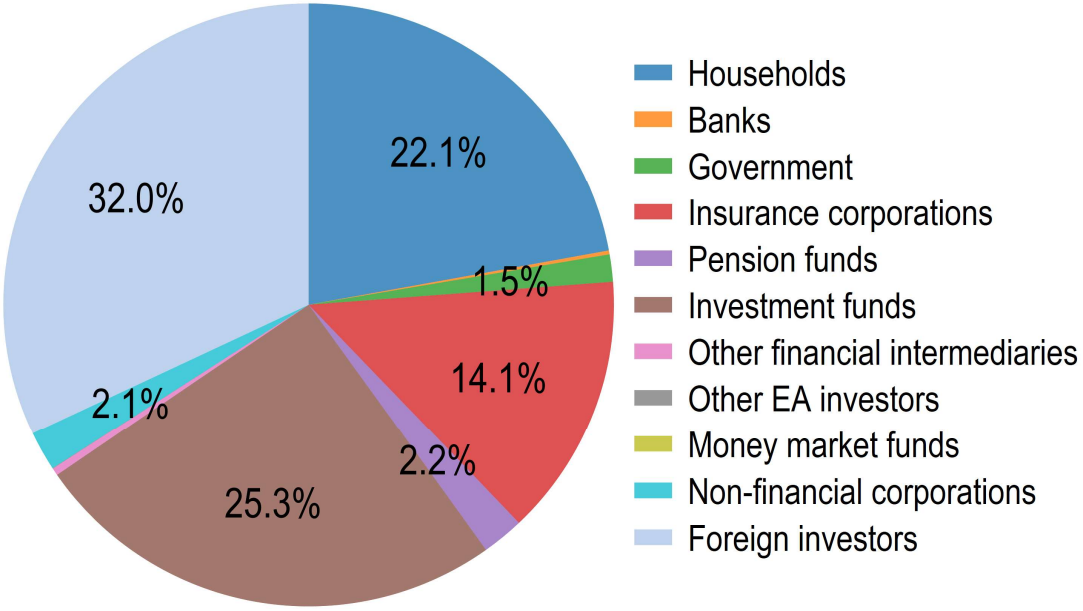
Assets under management of €370 bn in 2019-Q4

[back]

1. Equity funds: Fund ownership statistics (average)



4 largest shareholder types:

- Foreign sector: 32%
- Investment funds: 25.3%
- HHs: 22.1%
- Insurance companies: 14.1%

The remaining investors account for less than 10% of holdings

[back]

What about other fund types? Are bond funds special?

Yes and No!

Special: Bond funds faced far *larger* outflows than other fund types

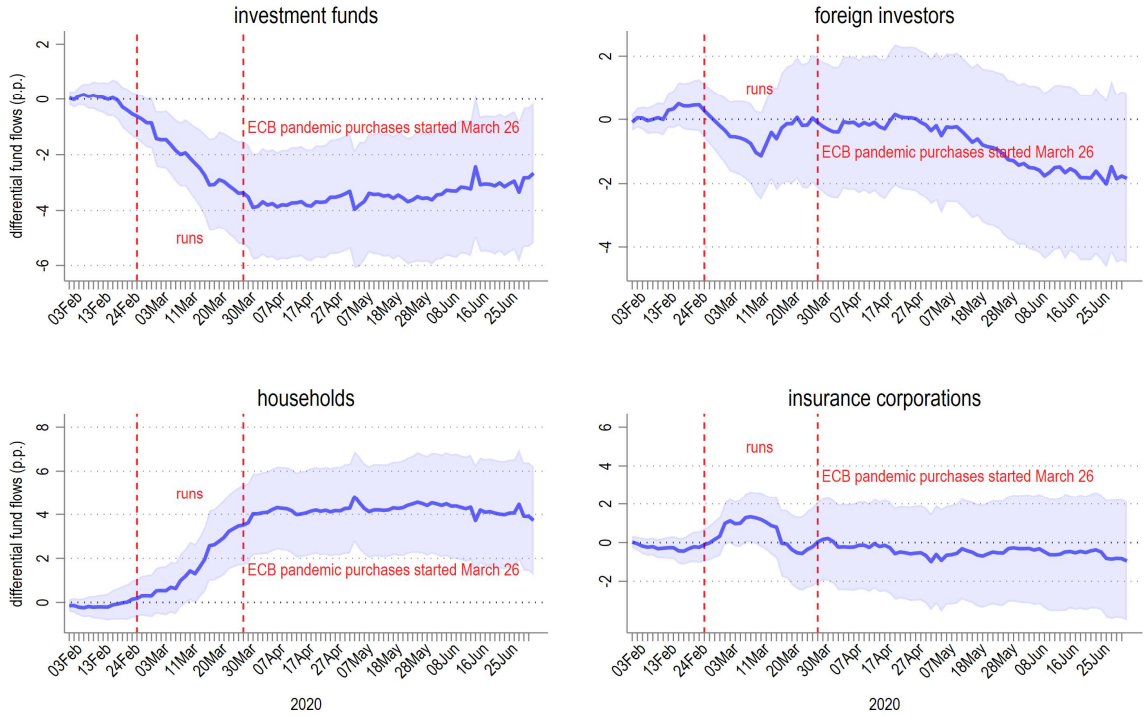
- consistent with the idea that illiquidity of assets is the key ingredient for runs on funds (Chen, Goldstein, Jiang, 2010; Goldstein, Jiang, Ng, 2017)

Similar in terms of investor base: other fund types are also often held by the investment fund sector and the foreign sector

- the fund sector is again the most run-prone sector, in relative terms

[equity funds] [diff-in-diff]

2. Equity fund flows: Differential impact by investor type



Key take-aways:

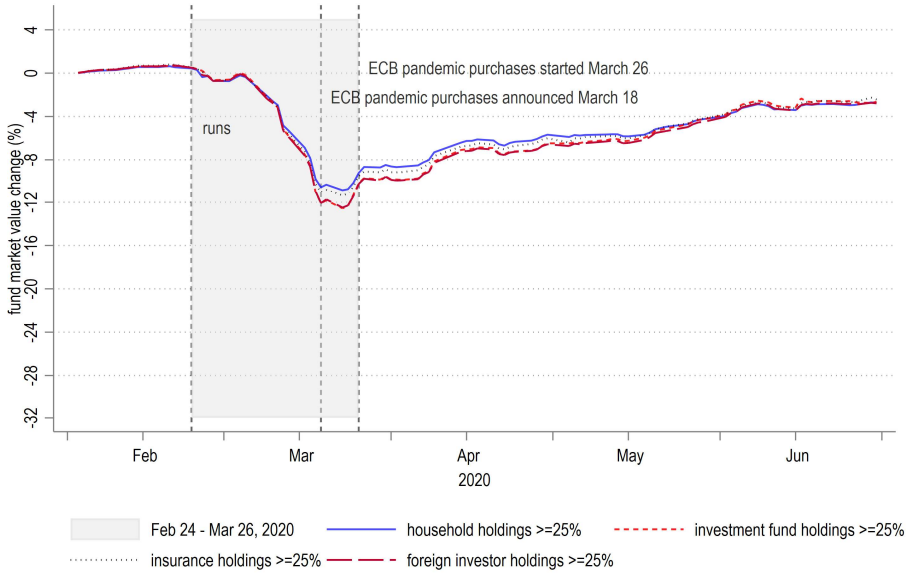
- no differential in outflows before the run onset
- fund-shares (within same fund) owned by Funds: differential (-) flow 4 p.p.
- fund-shares (within same fund) owned by HHs: differential (+) flow 5 p.p.

[back]

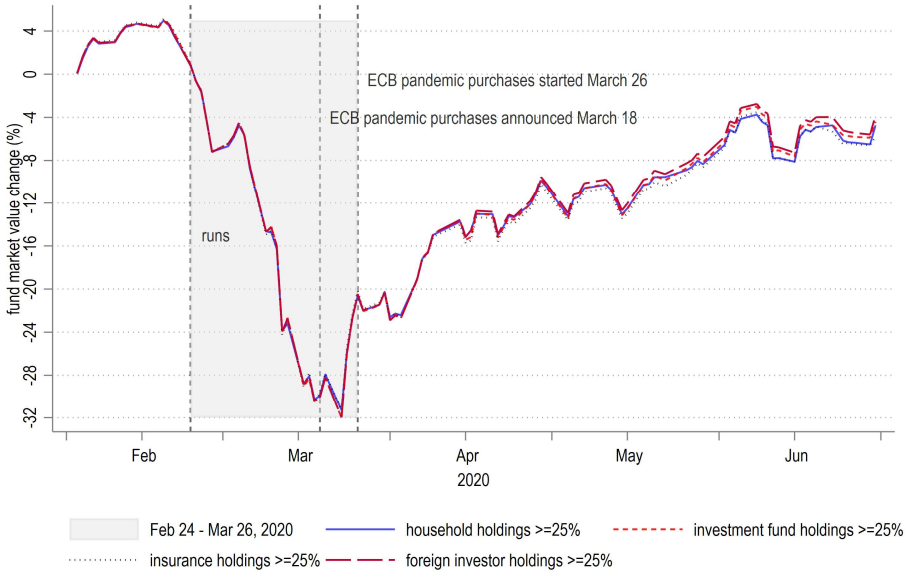
Note: Differential fund flows according to investor base.
Source: Refinitiv's Lipper, authors' calculations.

A. Bond versus Equity funds: Performance

Bond fund performance



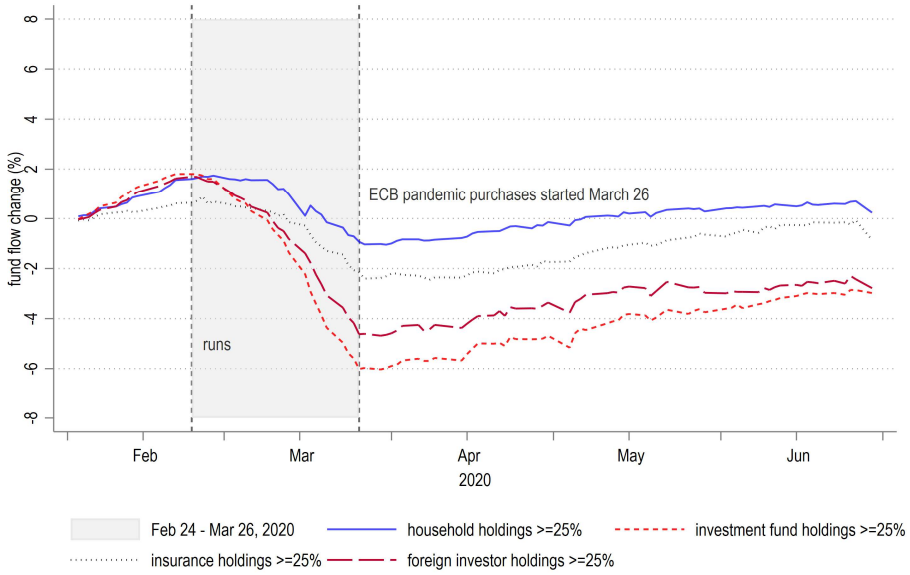
Equity fund performance



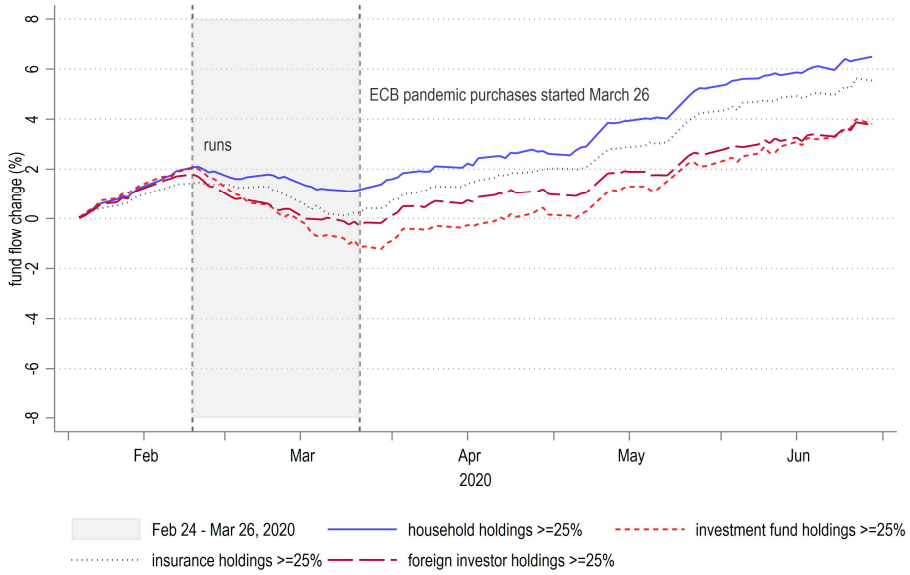
[back]

B. Bond versus Equity funds: Flows

Bond fund flows



Equity fund flows



[back]

“Dash for cash” in March 2020

Philip Lane, Chief Economist of the ECB, June 2020:

“**March 2020 was a pivotal month** in the escalation of the economic and financial dimensions of the pandemic crisis… **The global financial system was put under extraordinary strain**. The nature of the shock triggered an abrupt and significant desired rebalancing of portfolios… The collective scramble to implement this portfolio shift, with investors all looking to make similar trades, put pressure on market-making financial intermediaries and was associated with a **widespread dash for cash**.”

Mutual funds → largest net sellers of securities in EA in Q1 2020 (> €250 bn)

Relation to the literature

Financial stability risks of non-bank liquidity transformation:

- open-ended mutual funds are subject to first-mover advantages (Chen, Goldstein, Jiang, 2010; Goldstein, Jiang, Ng, 2017)
- illiquidity of fund assets and fire-sales (Chernenko, Sunderam, 2016; Morris, Shim, Shin, 2017; Zeng, 2017; Falato, Hortaçsu, Li, Shin, 2021; Fricke, Jank, Wilke, 2022)
- run incentives of institutional investors (Goldstein, Jiang, and Ng, 2017; Schmidt, Timmermann, Wermers, 2016)
- interconnectedness within the investment fund sector (Lane, 2020; Fricke, Wilke, 2023)
- **this paper: run incentives of different fund investors → investor base heterogeneity**

Runs on funds in March 2020:

- impact on financial markets and central bank interventions (e.g., Breckenfelder and Hoerova, 2021; Falato, Goldstein, Hortaçsu, 2021; Haddad, Moreira, Muir, 2021; Li, Li, Macchiavelli, Zhou, 2021; Ma, Xiao, Zeng, 2022; Vissing-Jorgensen, 2021)
- **this paper: in the "dash for cash" episode of March 2020, mutual funds provided liquidity to other funds**

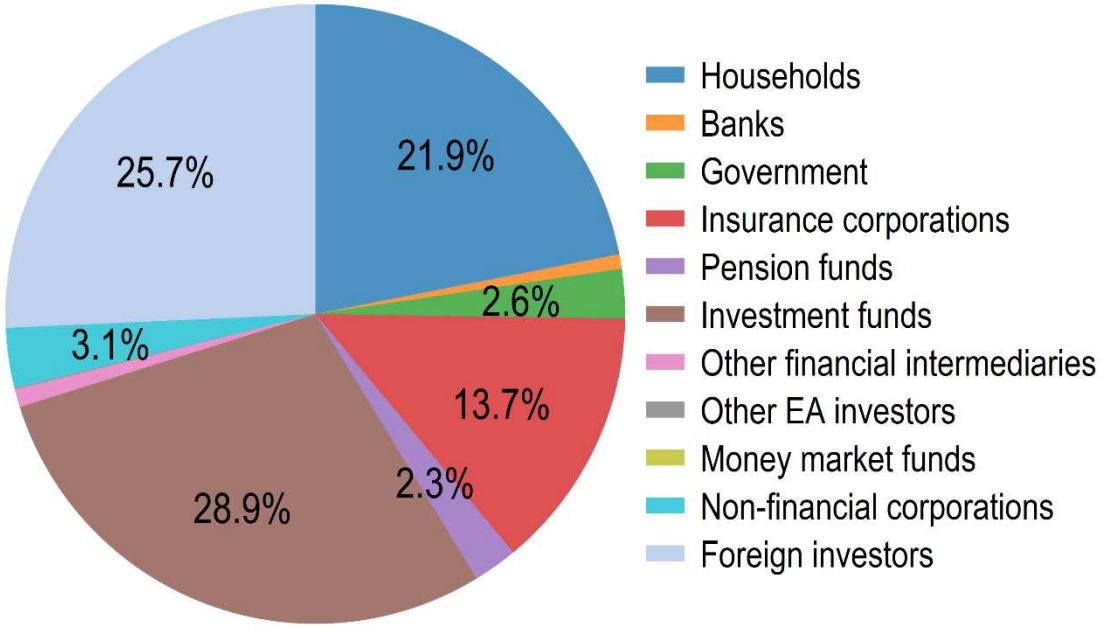
Data: Two main sources

1. Securities Holdings Database Aggregated by Sector (SHSS):
   - mandatory data reporting, collected by the national central banks in the EA
   - frequency: quarterly
   - holdings: all securities (ISIN-level) held in the EA or with an EA custodian
   - holder information: investor type (more than a dozen types) by country (EA/EMU countries, some coverage UK, Switzerland, rest-of-the-world)

2. Refinitiv's Lipper for Investment Fund Management:
   - detailed fund-level data (**bond**, equity, mixed, alternative…)
   - in/outflows (daily)

[back]

Summary statistics: Fund ownership (aggregate)



Final sample: 545 distinct bond mutual funds and 1,737 fund shares

Assets under management of €370 bn in 2019-Q4

[back]

Set-up: differential across shares within the same fund

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

$\Delta flows_{\mathrm{i,t}}$: the cumulative daily fund-share flow of fund-share i at time t, difference to February 3, 2020

$I_{k,t}$: take on the value of 1 for period k and zero otherwise

$InvestorType_i$: equal to 1 if a fund-share i is held by a specific investor type relatively more (above 25% ownership in the fund share)

$\mu_{fund,t}$: fund fixed effects times calendar date fixed effects (allow us to compare different fund shares within the same fund)

Standard errors are clustered at the fund level

[back]

Fund flows: Differential impact by investor type (weekly)

fund flow change (%)	(1) investment funds	(2) households	(3) insurance corporations	(4) 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

Funds owned by other Funds:

- the (-) flow differential amounts to 5.8 p.p.

Funds owned more by HHs:

- the (+) flow differential amounts to 4.5 p.p.

Funds owned by Insurances:

- the (+) flow differential amounts to 1.02 p.p.

[back]

Evolving thinking on liquidity in mutual funds

Mutual funds do not do liquidity transformation → liquidity not key

- mutual funds somewhat similar to banks, promise liquid claims, hold illiquid assets

Still, are there inefficiencies that warrant a regulatory intervention?

- first-mover advantage in fund redemptions → self-fulfilling runs
- to satisfy redemptions, fire-sales of assets → externality on all investors holding same assets

→ Proposals to regulate liquidity holdings of funds

- e.g., Securities and Exchange Commission, 2022; Dekker, Molestina Vivar, Wedow, Weistroffer, 2023

PEPP analysis: fund summary statistics

	lower eligible holdings			higher eligible holdings		
	mean	sd	N	mean	sd	N
Fund share characteristics						
fund Value (TNA) (mil)	171	680	393	160	399	391
annually compounded return (%)	7.140	5.088	360	5.052	4.313	346
Fund portfolio						
investment grade (% of total)	79	11	393	88	12	391
non-investment grade (% of total)	13	10	393	5	6	391
unrated (% of total)	8	8	393	7	15	391
eligible holdings (% of total)	5	6	393	46	24	391
euro area issuers (% of total)	26	21	393	68	22	391
US issuers (% of total)	42	30	393	15	13	391
other issuers (% of total)	32	20	393	17	13	391

[back]

PEPP: Difference-in-difference regression setup

$$x_{i,t} = \beta_0 + \sum_{k=1}^{5} \beta_k \, CrisisPeriod_{k,t} \times relMoreElig_i + \sum_{k=1}^{5} \varphi_k \, CrisisPeriod_{k,t} + \mu_i + X_t + \varepsilon_{i,t}$$

$x_{i,t}$: daily fund share flow or cumulative fund share performance

$CrisisPeriod_{k,t}$: 1 for sub−period *k* and zero otherwise (5 sub-periods *k*)

k: run-up (Mar 9–17), PEPP announced (Mar 18–25), PEPP implemented week 1 (Mar 26–Apr 1), week 2 (Apr 2–8), and thereafter

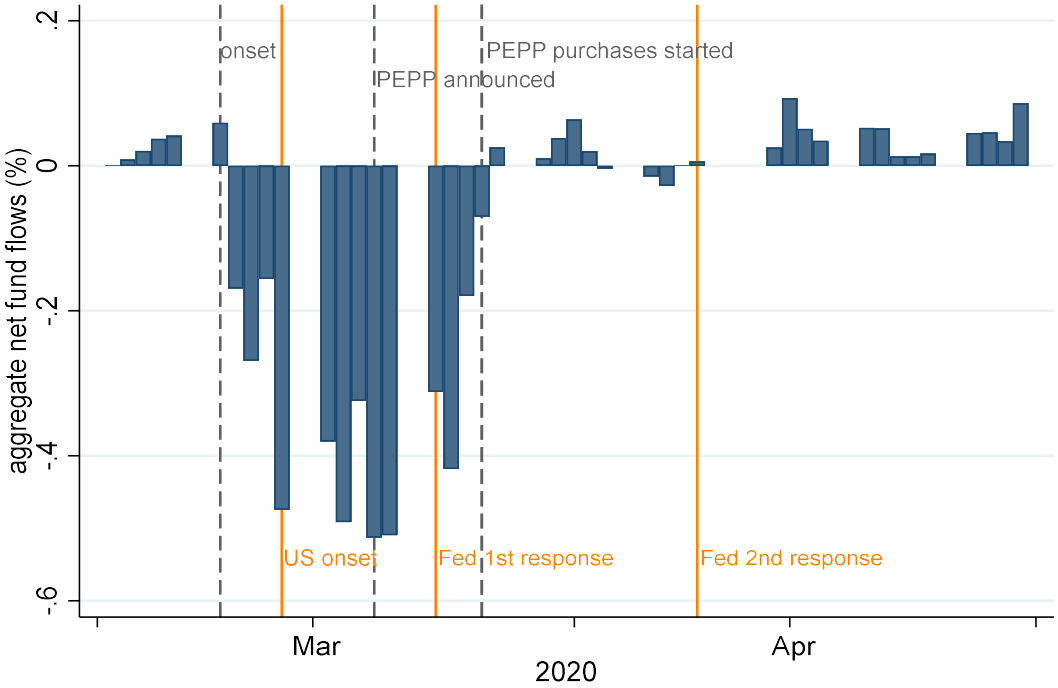
$relMoreElig$: 1 for above-the-median PEPP-eligible holdings at the end of Jan 2020

μ_i: fund share fixed effects

Standard errors are clustered at the fund level

[back]

Fed interventions



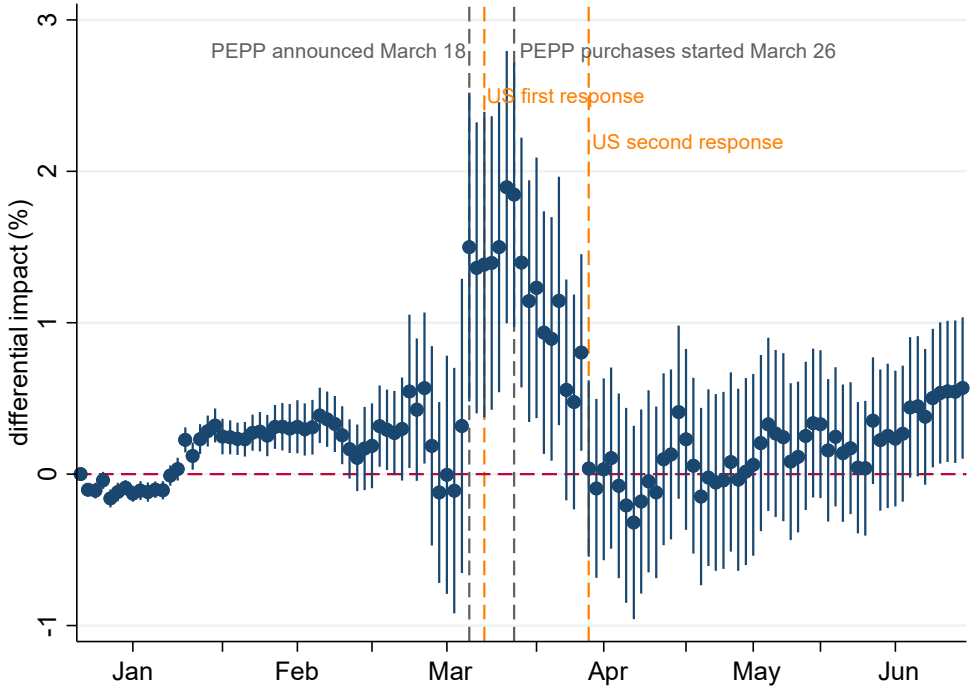
Three key periods in the US:

1. US crisis peak (Mar 13–22)
2. Fed 1st response (Mar 23–Apr 8): purchase of $300bn of investment-grade corporate bonds, QE expansion…
3. Fed 2nd response (Apr 9-17): purchase of $850bn of corporate bonds, incl. high-yield ETFs and "fallen angels"

[back]

Note: Daily average bond fund flows (investment grade): $flows_{i,t} = (TNA_{i,t} - (1 + r_{i,t}) * TNA_{i,t-1}) / TNA_{i,t-1}$.
Source: Refinitiv's Lipper, authors' calculations.

Zooming in on the PEPP



Note: Fund performance, regression coefficients on triple interactions. Source: Refinitiv's Lipper, authors' calculations.

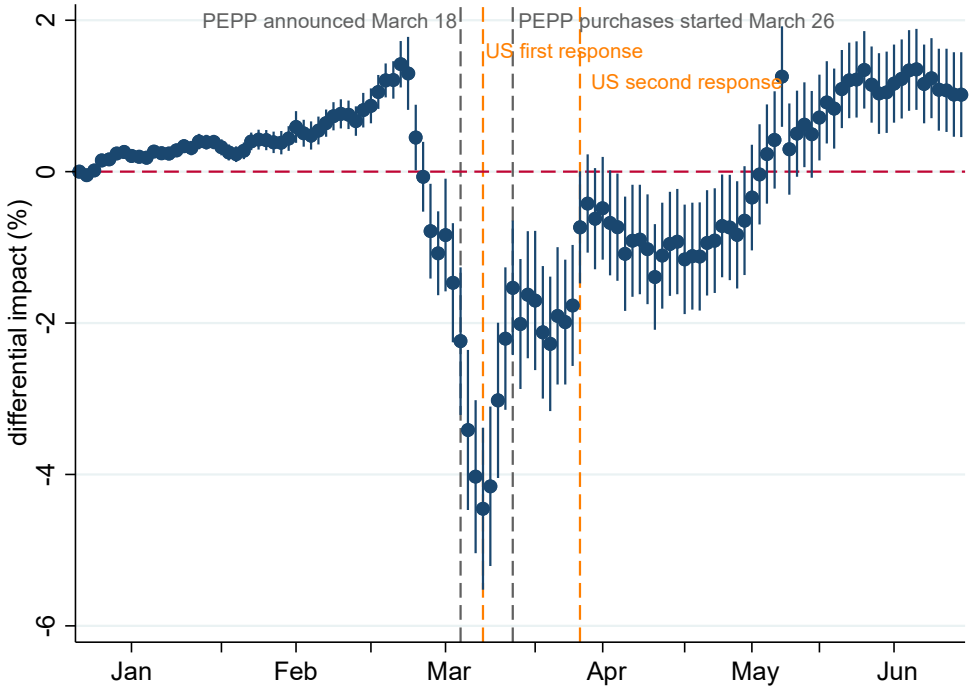
Performance differential for more PEPP-eligible group ($\beta_{1,t}$)

PEPP announcement day: differential performance for more PEPP-eligible equal to ca. 1.5 p.p.

Fed 2nd response: differential eliminated

[back]

Zooming in on the Fed interventions



Note: Fund performance, regression coefficients on triple interactions. Source: Refinitiv's Lipper, authors' calculations.

Performance differential for more Fed-eligible group ($\beta_{2,t}$)

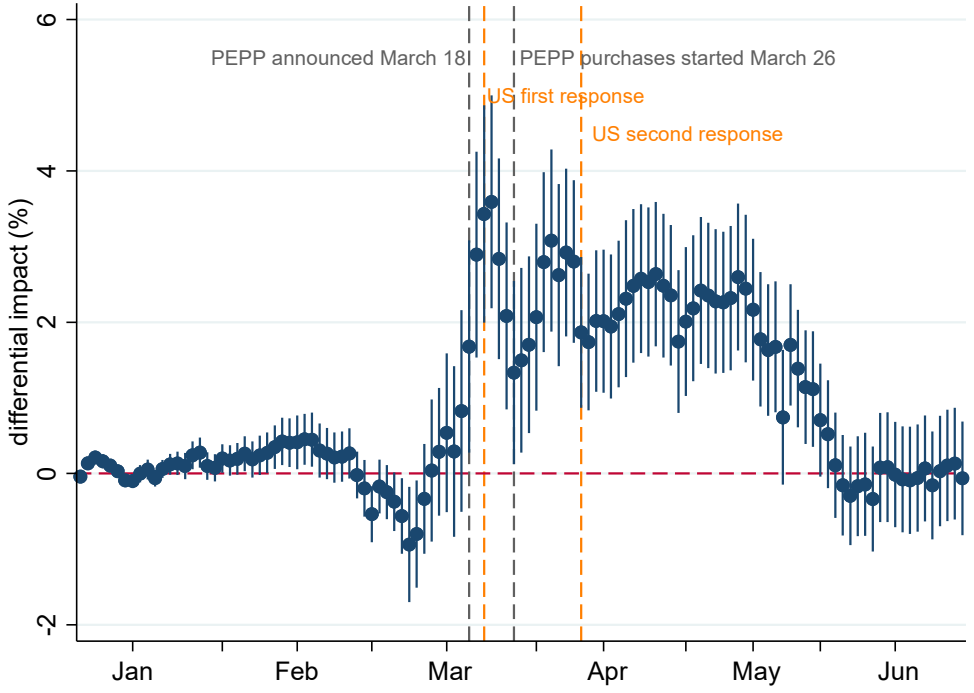
PEPP announcement: no response

Fed 1st response: change in slope

Fed 2nd response: performance differential improves

[back]

Combined PEPP and Fed interventions effect



Note: Fund performance, regression coefficients on triple interactions. Source: Refinitiv's Lipper, authors' calculations.

Performance differential for more PEPP-eligible, more Fed-eligible group ($\beta_{3,t}$)

PEPP announcement day: differential performance for more-eligible equal to ca. 2.5 p.p.

Fed interventions keep performance differential positive

[back]

Repo analysis: bank-fund summary statistics

	CP rollover need			no CP rollover need		
	mean	sd	N	mean	sd	N
Bank characteristics						
bank total assets (bn)	559	371	8	587	387	8
maturing CP March / bank total assets (%)	0.235	0.215	8	0.000	0.000	8
capital / bank total assets (%)	7.949	3.465	8	6.204	2.094	8
Bank-fund relationships						
repo outstanding amount, total (EUR mil)	167	505	315	105	348	355
repo new transaction volume, total (EUR mil)	334	1420	315	109	574	355

	lower excess reserves			higher excess reserves		
	mean	sd	N	mean	sd	N
Bank characteristics						
bank total assets (bn)	681	373	9	433	332	8
excess reserves / bank total assets (%)	3.144	0.462	9	6.449	2.893	8
capital / bank total assets (%)	7.738	2.818	9	6.227	3.011	8
Bank-fund relationships						
repo outstanding amount, total (EUR mil)	145	476	403	127	413	267
repo new transaction volume, total (EUR mil)	269	1260	403	135	653	267

[back]

Bridge LTROs: Khwaja, Mian (2008) regression setup

$$\Delta bank\ lending_{f,b} = \beta\ relHigherExposure_b + \mu_f + X_b + \varepsilon_{f,b}$$

$\Delta\ bank\ lending_{f,b}$: the log change in bank-fund repo transaction volumes over a week or week-on-week change in the stock of repos outstanding

LTRO announcement effect: Δ bw the week of March 11 and the previous week

1st LTRO settlement effect: Δ bw the week of March 18 and the previous week

$relHigherExposure_b$: 1 for banks with CP roll−over needs in Mar 2020 (scaled by total assets) or 1 for below−the−median excess reserves (scaled by total assets) in Jan 2020

μ_f: fund fixed effects; X_b: bank-level controls

Standard errors are clustered at the bank level

[back]

Bridge LTRO take-up: Regression setup

$$\Delta bank\ lending_{f,b} = \\ = \beta\ relHigherExposure_b \times LTROdummy_b + \gamma\ relHigherExposure_b + \delta\ LTROdummy_b + \mu_f + X_b + \varepsilon_{f,b}$$

$\Delta\ bank\ lending_{f,b}$: the log change in bank-fund repo transaction volumes over a week or week-on-week change in the stock of repos outstanding

$LTROdummy_b$: 1 if bank *b* borrowed liquidity in the 1st Bridge LTRO

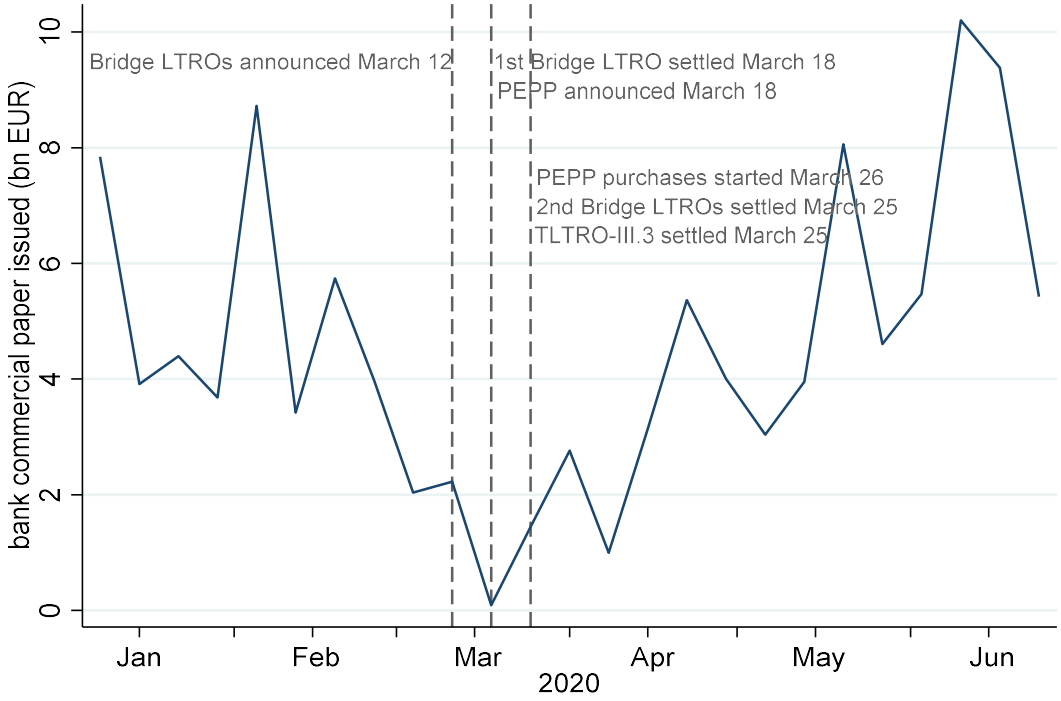
$relHigherExposure_b$:1 for banks with CP roll−over needs in Mar 2020 (scaled by total assets) or 1 for below−the−median excess reserves (scaled by total assets) in Jan 2020

μ_f: fund fixed effects; X_b: bank-level controls

Standard errors are clustered at the bank level

[back]

Commercial paper (CP) issuance came to a standstill



Note: Evolution of new issuances in the bank commercial paper market.
Source: CSDB, authors' calculations.

Split on CP roll-over:

- amount of bank CP maturing in March 2020 (ratio to TA)
- a measure of funding liquidity needs in the bank CP market

Split on excess reserves:

- amount of excess reserves held (ratio to TA) ex ante (Jan 2020)
- a measure of readily available liquidity

[back]