TRACING THE SOURCES OF FRAGILITY IN THE FINANCIAL SYSTEM

FEDERAL RESERVE BANK OF CLEVELAND
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OUTLINE

- Financial Fragility: Fundamentals and Panic
- Evidence from Banks
- Evidence from Mutual Funds
- Current Research: Banks
- Current Research: Mutual Funds
- Conclusion

Financial Fragility: Fundamentals and Panic

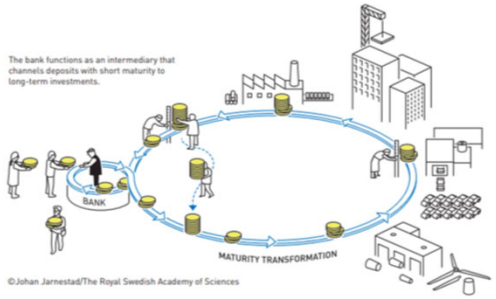
FINANCIAL FRAGILITY

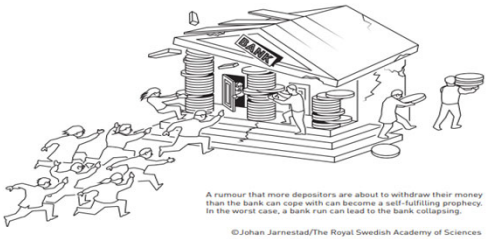
A run on American Union Bank, 1931

It's A Wonderful Life, 1946

THE BASIC STORY OF PANIC-BASED RUNS

- Liquidity transformation is at the core of banking
  - Banks provide liquidity to their depositors and invest in illiquid assets
  - They create liquidity, but end up with liquidity mismatch
- Liquidity mismatch renders banks vulnerable to panic-based runs (Diamond and Dybvig, 1983)
  - Depositors rush to withdraw deposits expecting that others will do so
  - This is known in game theory as "strategic complementarities"





FUNDAMENTALS OR PANIC?

- Fundamental-based vs. panic-based bank runs:
  - Fundamental-based runs happen when depositors withdraw just because of unfavorable news about banks' fundamentals
    - Chari and Jagannathan (1988), Jacklin and Bhattacharya (1988), Allen and Gale (1998)
  - Panic-based runs happen when depositors withdraw because they believe others will withdraw
    - The belief can be self-fulfilling because banks do not hold enough liquid assets to cover liquid liabilities which create strategic complementarity among depositors (Diamond and Dybvig, 1983)
- Separating panic-based run from fundamental-based run is important from a policy perspective
  - Many policies, such as deposit insurance, lender of last resort, suspension of convertibility, are premised on the idea that some bank runs are driven by panics
  - Many believe these policies distort banks' incentives and might create more problems than they solve

EMPIRICALLY TESTING FOR PANIC-BASED RUNS

- Long-standing evidence, going back to Gorton (1988), find strong association between bank runs and bank fundamentals
  - Such evidence was sometimes interpreted as supporting fundamental-based runs and against panic-based runs
- However, this interpretation is incorrect (e.g., Goldstein, 2013):
  - Diamond and Dybvig's (1983) approach of multiple equilibria is essentially untestable
  - Global-games approach of Goldstein and Pauzner (2005) and Rochet and Vives (2004) can provide a framework for empirical testing:
    - Association between runs and bad fundamental does not rule out the existence of panic-based behaviors
    - Panic can manifest itself as amplification of the effect of fundamentals
    - Alternative tests can be designed to identify panic
    - This was recently applied for recent data of the universe of US banks by Chen, Goldstein, Huang, Vashishtha (2024)

Evidence from Banks

IDENTIFYING PANIC

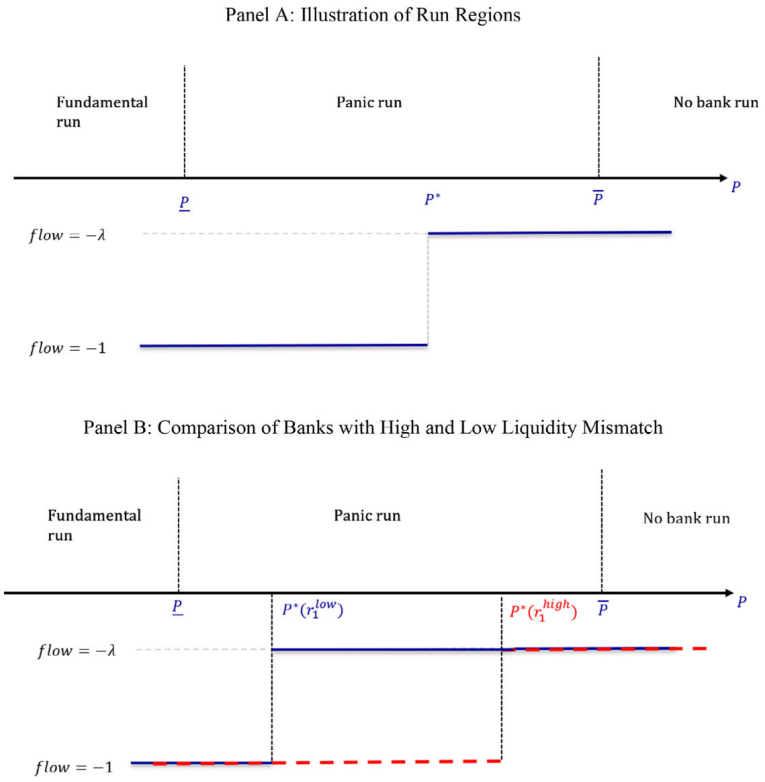


Figure 1. Illustration of the theoretical underpinning. This figure summarizes the main result from Goldstein and Pauzner (2005) on the withdrawal decisions of depositors in equilibrium. Panel A shows that impatient depositors always withdraw to meet their liquidity needs regardless of bank performance, resulting in an outflow of deposits at the level of $-\lambda$. Patient depositors, contributing portion $1-\lambda$ of bank funding, withdraw when they observe a (noisy) signal that indicates the bank's performance is below a threshold of P^*. Panel B shows that the threshold for withdrawal is higher for banks with a greater degree of liquidity mismatch (r_1). (Color figure can be viewed at wileyonlinelibrary.com)

- This figure from Chen, Goldstein, Huang, and Vashishtha (2024) illustrates the theoretical underpinnings
  - Depositors withdraw when their information falls below a threshold
  - Threshold is higher for banks with stronger strategic complementarities
    - That is, banks with a greater degree of liquidity mismatch
  - This leads to two predictions:
    - Conditional on low fundamentals, banks with a greater degree of liquidity mismatch will have more outflows
    - Banks with a greater degree of liquidity mismatch will have stronger sensitivity of outflow to bad performance

MEASURING LIQUIDITY MISMATCH

- Chen, Goldstein, Huang, and Vashishtha (2024) use two measures for the degree of liquidity mismatch:
  - The reliance on uninsured deposits
  - The illiquidity of the assets on the balance sheet (based on Berger and Bouwman, 2009)
- These measures capture liquidity mismatch from both sides of the balance sheet
- They both strengthen depositors' incentive to run even when bank is solvent, and just because of the fear that others will run
- Hence, when they amplify the response of depositors to fundamentals, this is evidence of panic at work
  - The balance sheets in the next slide illustrate this point

LIQUIDITY MISMATCH AND PANIC: SIMPLE BALANCE-SHEET ILLUSTRATION

Assume that haircut on loans is 40%

No reason to run since liquidation value of assets is higher than value of uninsured deposits

Assets		Liabilities and Equity	
Cash	50	Uninsured Deposits	75
		Insured Deposits	15
Loans	50	Equity	10
Total	100	Total	100

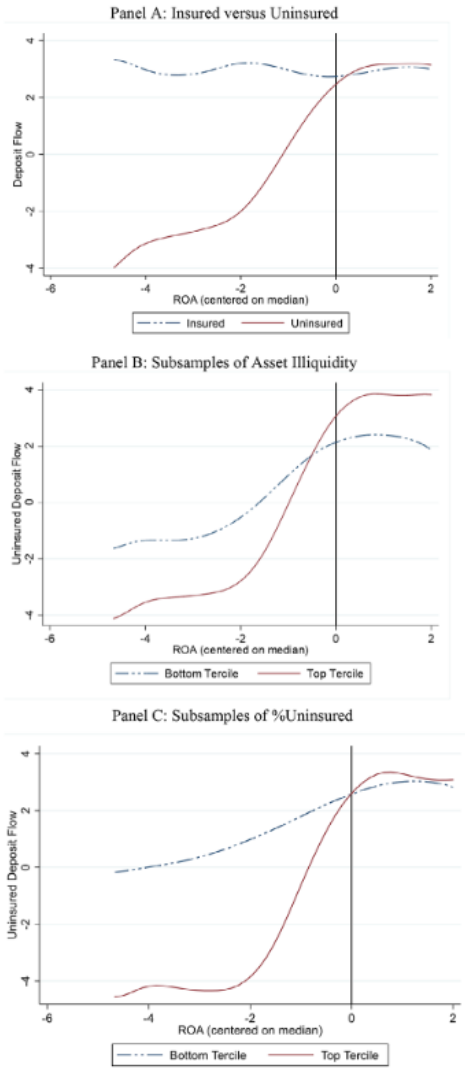
Assets		Liabilities and Equity	
Cash	20	Uninsured Dep	75
		Insured Dep	15
Loans	80	Equity	10
Total	100	Total	100

Here, illiquid assets create a reason to run even though bank is solvent

Assets		Liabilities and Equity	
Cash	50	Uninsured Dep	90
		Insured Dep	0
Loans	50	Equity	10
Total	100	Total	100

Here, uninsured deposits create a reason to run even though bank is solvent

PATTERNS OF DEPOSIT OUTFLOWS AND PANIC



- The semi-parametric analyses here capture the spirit of the results from Chen, Goldstein, Huang, and Vashishtha (2024)
  - Uninsured depositors respond strongly to bad performance, and insured depositors do not
  - Among the uninsured, the response is stronger when there is greater reliance on uninsured deposits and when the assets are less liquid
- Paper provides many regression analyses digging into the mechanism and exploring various tests as robustness and extensions

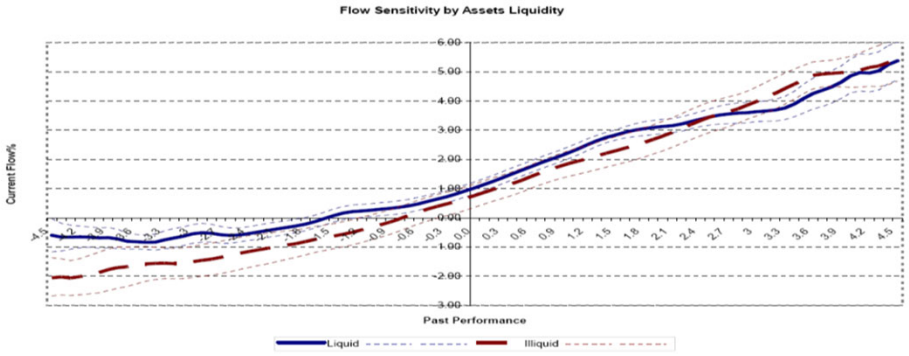
Evidence from Mutual Funds

THESE FORCES APPEAR ALSO IN NON-BANKS

- My journey with non-bank financial fragility started from the realization that these forces increasingly appear also in non-banks
- I focused on open-end mutual funds
  - Even though they do not promise a fixed return and pay according to a floating-NAV model, they create liquidity and generate strategic complementarities in redemptions
  - In a floating-NAV environment, investors can redeem shares and get the NAV as of the day of redemption
  - But their redemptions will affect fund trading going forward, hurting remaining investors in funds with illiquid assets
- Findings evolved along three papers as the phenomenon increased in significance

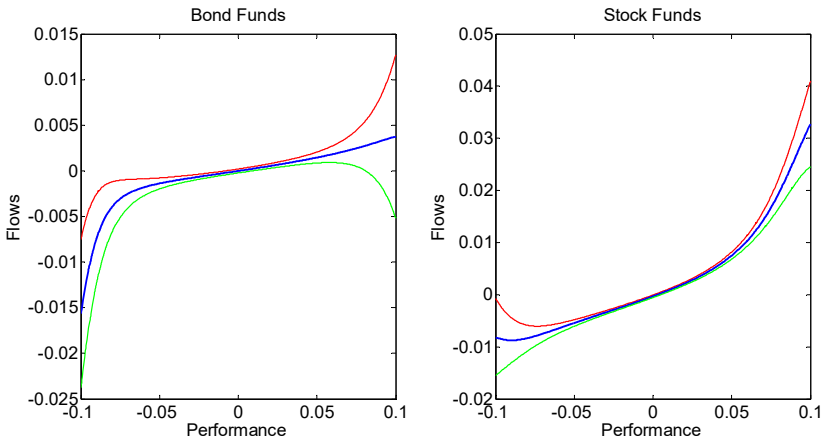
PAPER 1: EQUITY MUTUAL FUNDS

- Chen, Goldstein and Jiang (2010)
  - Stronger sensitivity of outflows to negative performance in illiquid equity funds relative to liquid equity funds
    - The illiquid funds exhibit stronger strategic complementarities
  - This supports predictions from global-games models of panic bank runs (Goldstein and Pauzner, 2005)
    - For the same decline in fundamental, higher liquidity mismatch will generate more outflows



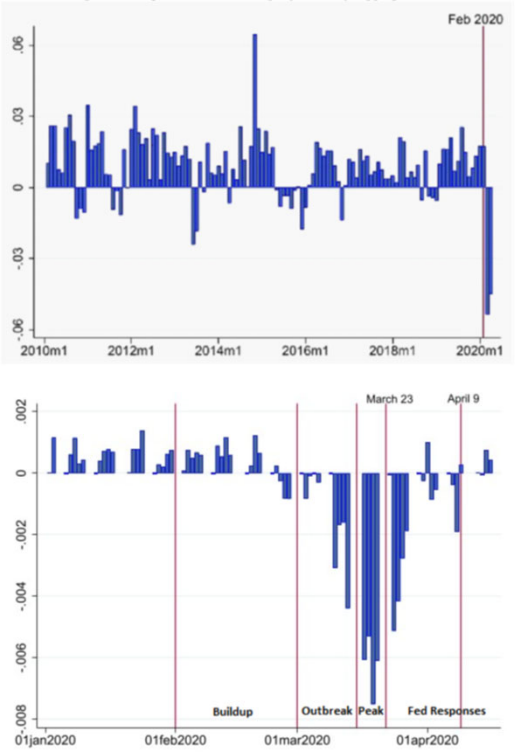
PAPER 2: CORPORATE-BOND MUTUAL FUNDS

- Goldstein, Jiang and Ng (2017)
  - Effect is much stronger in corporate-bond funds, where illiquidity of assets is a much bigger problem
    - These funds became much more prevalent in the aftermath of the Global Financial Crisis, given all the constraints on banks
  - The well-known convex flow-performance relation in equity funds turns to a concave relation in corporate-bond funds
    - Investors are more sensitive to bad performance when the underlying asset is illiquid



PAPER 3: COVID-19 EPISODE

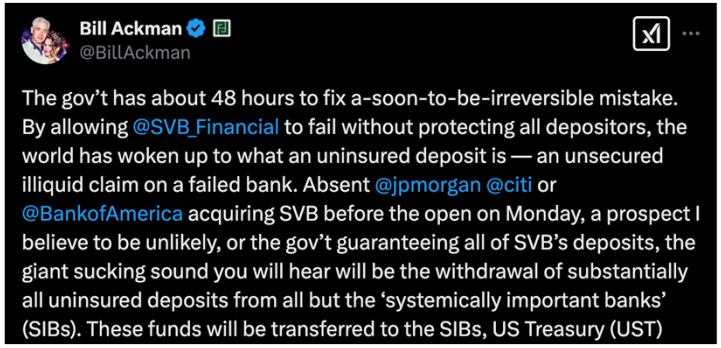
- Falato, Goldstein, and Hortacsu (2021)
  - Mutual funds in corporate bond markets saw unprecedented massive outflows during the COVID-19 crisis
  - Among corporate-bond funds, patterns were stronger in funds that held more illiquid assets
  - Quick interventions by central banks prevented a bigger meltdown



Current Research: Banks

EXTENDING RESEARCH ON BANK FRAGILITY: CONTAGION

- "Earnings Information Spillovers and Depositor Contagion" (Chen, Goldstein, Vashishtha, and Yin, 2025 WP)
- Spillovers across financial institutions have been crucial for understanding crises and responding to them
  - The 2008 Global Financial Crisis led to major introspection, as part of the regulatory effort that followed the crisis, about the role of interbank connections
  - The failure of Silicon Valley Bank in 2023 generated fears of a market-wide loss of depositor confidence leading regulators to respond with unusual force



MECHANISMS FOR SPILLOVERS ACROSS BANKS

- Casual evidence suggest that three interacting mechanisms are at work
  - Correlation across banks' assets and business models lead depositors to withdraw in focal bank when peer banks have issues
  - Panic aggravates depositors' reaction
    - Panic comes from strategic complementarities, or first mover advantage, that are generated by liquidity mismatch on banks' balance sheets
  - Banks' interconnections amplify these forces further
    - Banks' have direct exposure to each other
    - Or they indirectly affect each other through fire-sales in asset market
- These mechanisms have been integrated and studied in theory
  - See recent papers by Liu (2023) and Goldstein, Kopytov, Shen, and Xiang (2024)

LOOKING FOR EMPIRICAL EVIDENCE

- Despite advancements in theory, there is no clear large-scale empirical evidence supporting the mechanisms
- This is particularly important when it comes to panic and fire-sale externalities
  - These are amplifying the response to the initial shock and providing rationale for forceful intervention
- This is what we attempt to do in this paper extending the empirical framework in Chen, Goldstein, Huang, and Vashishtha (2024) to a cross-bank setting
  - Panic works in a richer setting
    - Amplifying not only own-bank shock but also contagion
  - Exploring multi-dimensional liquidity mismatch
    - Looking at effect of focal bank mismatch, peer bank mismatch, and interaction of the two
  - Exploring presence of and interactions with other channels for contagion
    - Asset correlation and fire-sale pressure

MEASURING PEER PERFORMANCE

- We attempt to detect spillovers between competing geographic peers in local banking markets
- We devise a summary measure of earnings performance of peer-banks (*PeerROA*) and then examine whether the uninsured depositors of the focal bank respond to *PeerROA*
- *PeerROA* is calculated in two steps:

$$CountyPeerROA_{c,t} = \sum_{j} w_{j,t}^{c} \, ROA_{j,t} \, , where \; w_{j,t}^{c} = \frac{Deposits_{j,t}^{c}}{\sum_{j} Deposits_{j,t}^{c}} \qquad (1)$$

$$PeerROA_{i,t} = \sum_{c} w_{i,t}^{c} \, CountyPeerROA_{c,t} \, , where \; w_{i,t}^{c} = \frac{Deposits_{i,t}^{c}}{\sum_{c} Deposits_{i,t}^{c}} \qquad (2)$$

EXPLORING THE ROLE OF PANIC

- We detect panic-based withdrawals by exploiting cross-bank variation in two features that capture liquidity mismatch which is at the root of such incentives
  - Reliance on Uninsured deposit financing (*%Uninsured)*
  - The degree of asset illiquidity (*Asset Illiquidity*)
- Chen, Goldstein, Huang, and Vashishtha (2024) use the above approach to document that depositors' response to their own bank's *ROA* reflects an element of panic:
  - Uninsured depositors respond more strongly to decline in ROA at banks with higher %Uninsured and Asset Illiquidity
- We look at the way panic might amplify the response to peer banks' *ROA*

REGRESSIONS TO DETECT PANIC

- There are two testable predictions to detect panic-based withdrawals triggered by high *%Uninsured* or *Asset Illiquidity* (i.e., *Mismatch)*
  - First, the average sensitivity of uninsured depositors' flows to news about bank performance will be stronger for banks with more *Mismatch*
  - Second, conditional on a given level of poor performance, we also expect lower levels of uninsured deposit flows for banks with more *Mismatch*

$$\Delta Dep^{u}_{i,t} = \alpha_i + \beta_0 PeerROA_{i,t-1} + \beta_1 MisMatch_{i,t-1} * PeerROA_{i,t-1} + \beta_2 MisMatch_{i,t-1} + Controls_{i,t-1} + \varepsilon_{i,t} \quad (5a)$$

$$\Delta Dep^{u}_{i,t} = \alpha_i + \beta_0 I_{PeerROA<Med} + \beta_1 MisMatch_{i,t-1} * I_{PeerROA<Med} + \beta_2 PeerROA_{i,t-1} + Controls_{i,t-1} + \varepsilon_{i,t} \quad (5b)$$

- Importantly, we examine the effects of *Mismatch* at both focal and peer banks

EFFECTS OF FOCAL BANK FRAGILITY

VARIABLES	(1) ch_DepU	(2) ch_DepU	(3) ch_DepU	(4) ch_DepU
	Sensitivity test		Level test	
Fragility measure	Focal%Uninsured	Focal Asset Illiquidity	Focal%Uninsured	Focal Asset Illiquidity
PeerROA	1.129***	1.379***	1.105***	1.374***
	(3.78)	(3.94)	(2.73)	(3.05)
Fragility x PeerROA	0.050***	4.006***		
	(3.00)	(4.52)		
Fragility	-0.198***	2.905	-0.133***	8.390***
	(-3.69)	(1.34)	(-3.48)	(5.49)
I(PeerROA<Med)			-0.373*	-0.242
			(-1.96)	(-1.25)
Fragility x I(PeerROA<Med)			-0.049***	-3.801***
			(-3.46)	(-4.38)
ROA	1.043***	1.024***	1.063***	1.059***
	(8.07)	(8.07)	(7.47)	(7.47)
Observations	362,859	362,859	362,859	362,859
Adjusted R-squared	0.135	0.125	0.134	0.125
Interactive Control	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Macro Control	Yes	Yes	Yes	Yes

	One σ increase in Focal %uninsured	**One σ increase in Focal asset illiquidity**
Effect on flow-perf. sensitivity	**+62%**	**+41%**
Effect on level of uninsured flows	**-29%**	**-22%**

EFFECTS OF PEER BANK FRAGILITY

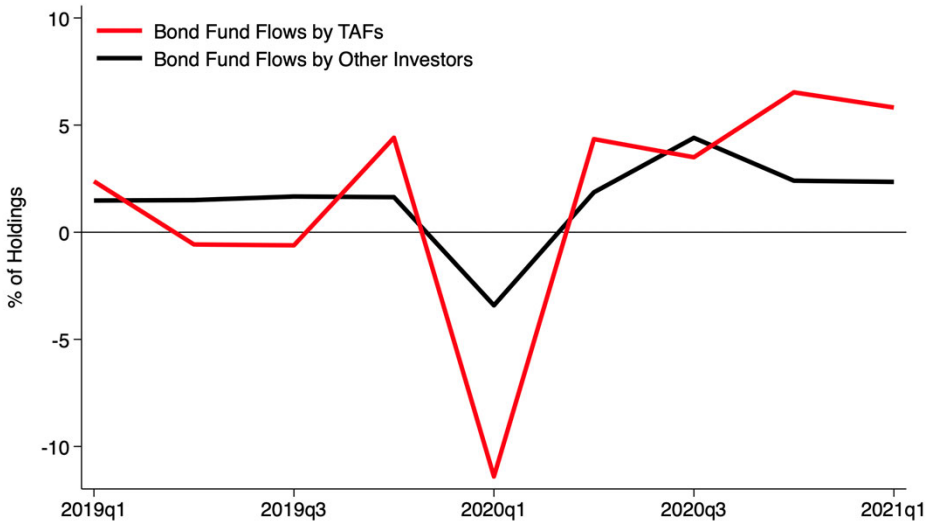
VARIABLES	(1) ch_DepU	(3) ch_DepU	(2) ch_DepU	(4) ch_DepU
	Sensitivity test		Level test	
Fragility measure	Peer%Uninsured	Peer Asset Illiquidty	Peer%Uninsured	Peer Asset Illiquidty
PeerROA	1.409***	1.192***	1.377***	1.261***
	(3.77)	(3.63)	(2.95)	(2.86)
Fragility x PeerROA	0.053***	6.914***		
	(2.68)	(4.53)		
Fragility	-0.112**	-7.372**	-0.044	2.394
	(-2.50)	(-2.18)	(-1.44)	(1.16)
I(PeerROA<Med)			-0.351*	-0.270
			(-1.84)	(-1.41)
Fragility x I(PeerROA<Med)			-0.054***	-7.693***
			(-3.72)	(-4.41)
ROA	1.001***	1.031***	1.024***	1.055***
	(8.62)	(8.23)	(7.85)	(7.66)
Observations	362,706	362,277	362,706	362,277
Adjusted R-squared	0.128	0.125	0.126	0.124
Interactive Control	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Macro Control	Yes	Yes	Yes	Yes

	One σ increase in Peer %uninsured	**One σ increase in Peer asset illiquidity**
Effect on flow-perf. sensitivity	**+47%**	**+52%**
Effect on level of uninsured flows	**-28%**	**-29%**

Current Research: Mutual Funds

EXTENDING RESEARCH ON MUTUAL FUND FRAGILITY: TARGET ALLOCATION FUNDS

- "Target Allocation Funds, Strategic Complementarities, and Market Fragility" (Fang and Goldstein, 2025 WP)
- Target Allocation Funds (TAFs) maintain a target allocation in bond and equity markets
- When equity prices drop, they reallocate money from bonds to equity
  - This was an important driver of outflows from bond funds during the Covid-19 crisis



USING THIS SETTING TO TEST FOR STRATEGIC COMPLEMENTARITIES

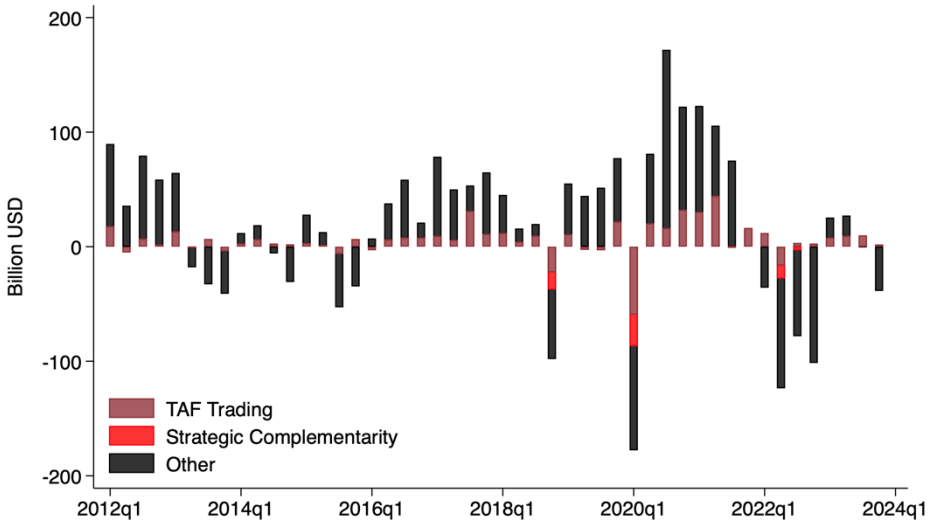
- This setting provides a unique opportunity to test for the presence of strategic complementarities
- Other investors, who are holding money in funds held by TAFs might want to withdraw knowing that the TAFs are withdrawing
- The table here shows that this is indeed the case, especially for the illiquid funds

$$\frac{Flow_{j,t} - Flow_{j,t}^{TAF}}{TNA_{j,t-1} - TNA_{j,t-1}^{TAF}} = a + b\frac{\sum_i \widetilde{RIT}_{i,j,t}}{TNA_{j,t-1}} \times Illiquidity_{j,t-1} + e_{j,t}$$

Dependent Variable:	2020Q1 Flow ex Trading by TAF (% of 2019Q4 TNA ex Holding by TAF)	
	(1)	(2)
Rebalancing-Induced Trading (% of TNA)	0.684***	0.402***
	(3.326)	(2.853)
RIT × 1[Illiquid Fund]		0.418**
		(2.017)
Controls	alpha, lagged flow, log TNA, log age, expense ratio, rear load, illiquidity	
Style FE	Y	Y
Standard Errors	clustered by Lipper style	
Observations	1190	1190
R2	0.327	0.328

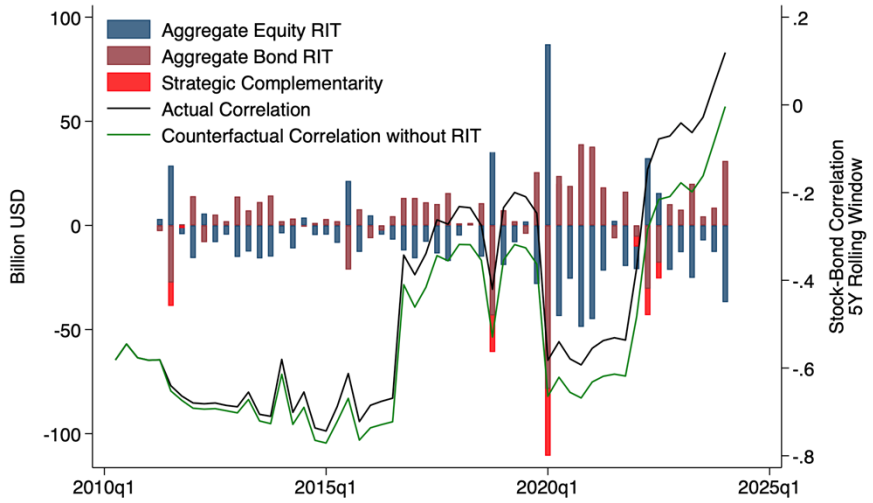
AMPLIFIED AGGREGATE BOND FUND OUTFLOWS

- These strategic complementarities amplify the effect of TAFs' rebalancing on bond-fund redemptions
- We can see here that TAF rebalancing + strategic complementarities account for roughly 50% of bond fund outflows



AGGREGATE STOCK-BOND CORRELATION

- There are implications of this pattern for financial markets more broadly
- It leads to an increase in the correlation between equity and bond prices
- TAF rebalancing + Strategic Complementarities explain 17% of the increase in stock-bond correlation over the past decade



Conclusion

SOURCES OF FRAGILITY

- Liquidity transformation generates strategic complementarities that cause fragility in the financial system
  - Utilizing insights from theory, we can find evidence in the data
  - Strategic complementarities cause panic that amplifies the direct effect of fundamentals
  - Phenomenon extended from banks to non-banks over the years, given evolution of regulation and technology
- Beyond that, interconnectedness of institutions interacts with and amplifies the effect of liquidity transformation
  - Interconnectedness can be direct through positions held by some institutions in others or indirect through fire-sale externalities

REGULATIONS AND POLICIES

- This is the kind of fragility that calls for regulation or intervention to limit negative externalities
- Governments have intervened to limit panic affecting both banks and non-banks
- Regulation of non-banks is still much more limited than that of banks
- For example, there has been slow progress in enacting measures to limit fragility of open-end mutual funds
  - Improving liquidity of underlying corporate bond assets
  - Requiring funds to hold more liquid securities and cash
  - Reducing liquidity available to investors through swing pricing in redemptions

NEW DIMENSIONS OF RISK

- The Silicon-Valley-Bank crisis showed how recent technology might have amplified the effect of strategic complementarities:
  - Digital banking makes withdrawals easier and faster
  - Social media can facilitate the exchange of information and coordination on destabilizing actions
- These patterns might become even stronger with emerging technological developments
  - Stablecoins
  - Tokenized deposits
- Policymakers should consider these developments alongside accumulating evidence on panic and fragility