

When Cash Flows Turn Negative: Liquidity-Driven Selling by Pension Funds

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- ▶ Hence, pension funds need to liquidate part of their portfolios to meet obligations.
- ▶ **Research Question:** How do pension funds incorporate negative cash flows in their asset allocation decisions?

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Main policy implication: Negative cash flows limit the ability of pension funds to act as stabilizers in market downturns.

Related Literature

1. Investment decisions by U.S. public pension funds (e.g., Lucas and Zeldes 2009, Hochberg and Rauh 2013, Andonov et al. 2017, Lu et al. 2019, Begenau et al. 2023)
 - ▶ **Contribution:** focus on pension funds' operating cash flows and liquidity needs + granular security-level data on all asset classes.
2. Long-term investors as market stabilizers (e.g., Timmer 2018; Chodorow-Reich et al. 2021, Zhou 2024, Coppola 2025)
 - ▶ **Contribution:** pension funds are regular net seller in equity markets because of negative cash flows.
3. U.K. pension crisis (e.g., Pinter 2023, Pinter et al. 2024, Alfaro et al. 2024)
 - ▶ **Contribution:** less derivative usage by U.S. public pension funds, but liquidity issues arise mostly from shocks to pension contributions.
4. Demand-based asset pricing (e.g., Koijen and Yogo 2019, Bretscher et al. 2020, Fang et al. 2022, Eren et al. 2023, Gabaix et al. 2023, 2025)
 - ▶ **Contribution:** understanding drivers of asset demand for U.S. public pension funds.

Aggregate Pension Fund Data

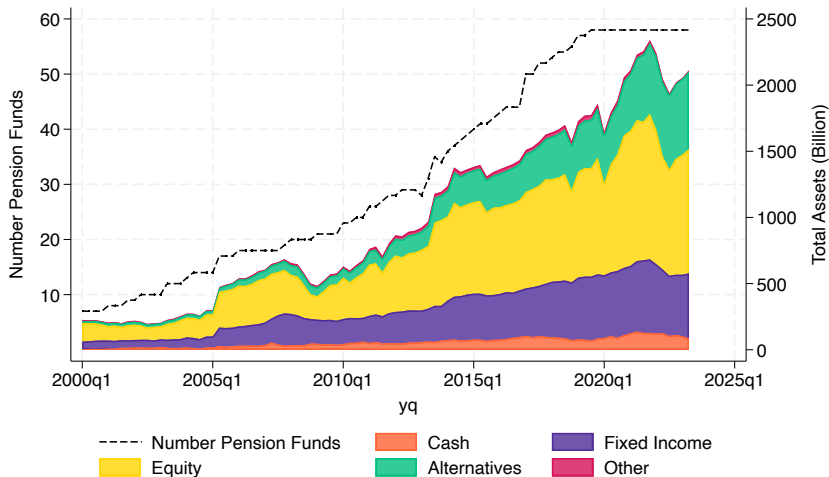
- ▶ Our sample covers 186 U.S. public pension funds over the 2001–2023 period (\$5 trillion in AUM covering 93% of total pension assets).
 - ▶ 145 pension funds from Public Pension Database (PPD) and 41 local and city pension funds hand-collected.
- ▶ From these sources, we obtain information on pension fund size, cash flows, actual and target asset allocations, funding status, and other characteristics.

Pension Fund Summary Statistics

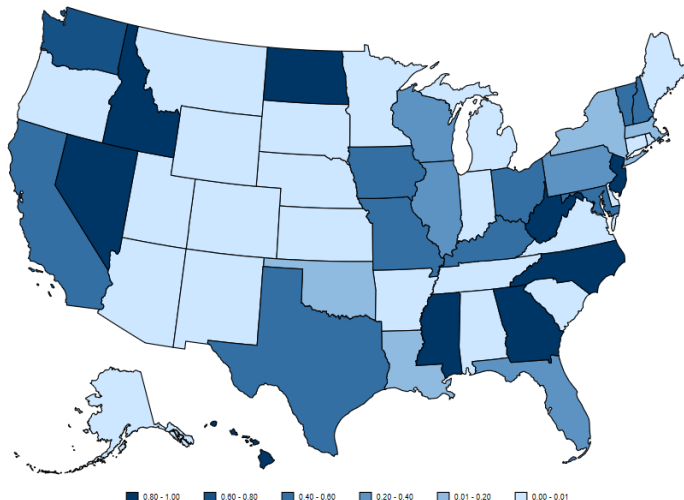
FOIA Requests Process

- ▶ We sent formal data requests under the Freedom of Information Act (FOIA).
- ▶ Requested [security-level asset holdings](#) from [2000Q1–2023Q2](#), including: equities, fixed income, derivatives, private assets, and cash.
- ▶ We classify a fulfilled request as successful if:
 1. The pension fund provided quarterly data for at least a period of five years.
 2. The pension fund delivered data on all asset classes but alternatives.
 3. The total assets align with those reported in PPD.
- ▶ To date, 59 pension funds ($\approx 5,000$ holdings per fund-quarter) fulfill this criteria.
 - ▶ The FOIA subsample is representative for the full sample.
 - ▶ The subsample covers larger pension funds on average.
 - ▶ The coverage is unrelated to cash flows, funding status, and asset allocation.

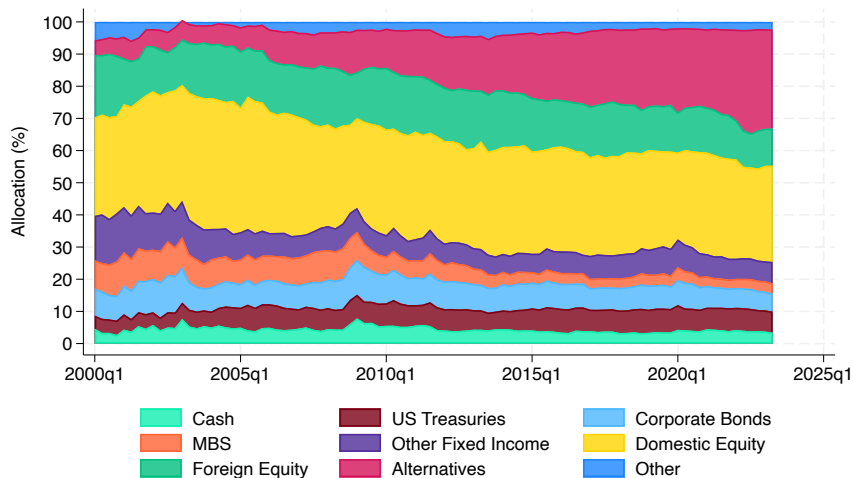
Data Coverage of Successful FOIA Requests



Geographical Coverage of Successful FOIA Requests



Detailed Actual Asset Allocation Over Time



Hypotheses Development

Liquidity buffer hypothesis

- ▶ Standard life cycle models, ALM models, and spending policy literature all imply that mature pension funds should allocate more to liquid and safe assets (Viceira 2001, Sharpe and Tint 1990, Campbell et al. 2024).

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- ▶ Investment flows: (Un)expected liquidity needs are met by drawing down cash and Treasuries; equities and alternatives are largely left unchanged (liquid-asset-first approach).

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Pro-rata hypothesis

- ▶ Pension funds may have little incentive to maintain higher target allocations to safe, liquid assets because cash delivers lower expected returns (Wermers 2000).
 - ▶ Reinforced by GASB accounting rule: discounting liabilities using expected returns.

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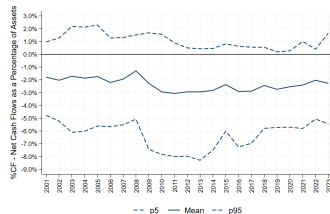
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- ▶ Target allocation: target weights do not reflect OCF; pension funds keep their preferred risky asset allocation despite cash flow status.
- ▶ Investment flows: Sales are approximately proportional to portfolio weights across asset classes.
 - ▶ In practice, pro-rata selling may be constrained, leaving illiquid assets untouched.

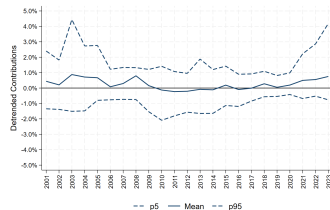
Measuring Cash Flows

- ▶ Net operating cash flows ($\%CF$) are measured as the inflows from contribution payments minus outflows for benefit payments and administrative expenditures.
- ▶ We decompose net cash flows into expected and residual cash flows.
 - ▶ We regress the contributions and benefits of each pension fund separately on an annual trend variable (using robust regressions).
 - ▶ $\%CF$ *Fit*: difference between fitted contributions and benefits.
 - ▶ Highly correlated with ratio retirees to active members.
 - ▶ $\%CF$ *Residuals*: difference between residual contributions and benefits.
 - ▶ Driven mostly by contribution freezes or additions (e.g., during GFC and COVID-19).
- ▶ Our results are robust to using *predicted* cash flows, where contributions and benefits are predicted from fitted trends over the past 10 years.

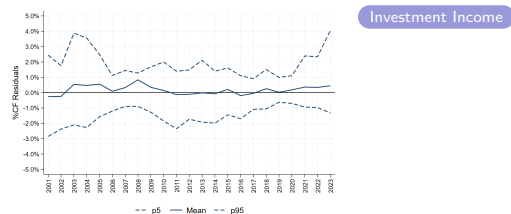
Fitted and Residual Cash Flows



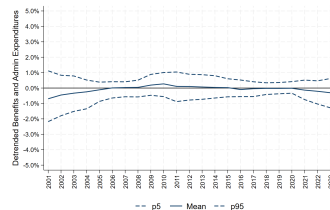
(a) Panel A: Net Operating Cash Flows



(c) Panel C: Detrended Contributions



(b) Panel B: Detrended Residual Cash Flows



(d) Panel D: Detrended Benefits

Target Asset Allocation and Cash Flows

- ▶ We estimate the following specification $\omega_{i,t} = \beta CF_{i,t} + \Gamma X_{i,t-1} + \theta_t + PF_i + \epsilon_{i,t}$, with $\omega_{i,t}$ the target allocation to cash & FI, equity, or alternatives.
- ▶ Pension fund target allocations are independent of their operating cash flows.

	Cash & FI		Equity		Alternatives	
	(1)	(2)	(3)	(4)	(5)	(6)
Mean Dep. Var.	0.258	0.258	0.503	0.503	0.239	0.239
Panel A: Net Cash Flows						
%CF	0.020 [0.078]	-0.086 [0.053]	-0.153 [0.113]	0.038 [0.041]	0.133 [0.135]	0.048 [0.053]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Pension Fund FE		Yes		Yes		Yes
Year-Reporting-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,342	3,342	3,342	3,342	3,342	3,342
R-squared	0.141	0.579	0.207	0.732	0.305	0.765
Panel B: Fitted Cash Flows						
%CF Fit	0.114 [0.166]	-0.188 [0.347]	-0.392 [0.250]	-0.317 [0.412]	0.279 [0.298]	0.505 [0.462]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Pension Fund FE		Yes		Yes		Yes
Year-Reporting-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,342	3,342	3,342	3,342	3,342	3,342
R-squared	0.142	0.578	0.210	0.732	0.306	0.766

Actual Asset Allocation to Cash+Treasuries and Cash Flows

- ▶ We repeat the results for allocations to cash and U.S. Treasuries obtained through FOIA requests.
- ▶ Again, we conclude that pension funds do not take cash flows into account in their asset allocation decisions.

	(1)	(2)	(3)	(4)
Mean Dep. Var.	0.109	0.109	0.109	0.109
%CF	-0.273 [0.279]	0.034 [0.163]		
%CF Fit			-0.838 [0.485]	-1.396 [1.234]
Controls	Yes	Yes	Yes	Yes
Pension Fund FE		Yes		Yes
Year FE	Yes	Yes	Yes	Yes
Observations	735	735	735	735
R-squared	0.146	0.701	0.181	0.707

Flows to Aggregate Asset Classes and Cash Flows

- ▶ We measure flows as: $Flow_{i,j,t} = \frac{A_{i,j,t} - A_{i,j,t-1} \times (1 + R_{j,t}^{BM})}{TA_{i,t-1}}$.
- ▶ We run the following regression: $Flow_{i,j,t} = \beta CF_{i,t} + \Gamma X_{i,t-1} + \theta_t + PF_i + \epsilon_{i,j,t}$.
- ▶ Pension funds absorb **expected** cash outflows by constrained **pro-rata** selling.
- ▶ Pension funds absorb negative cash flow **shocks** mostly by selling **equities**.

	Cash & FI		Equity		Alternatives	
	(1)	(2)	(3)	(4)	(5)	(6)
Mean Dep. Var.	-0.005	-0.005	-0.026	-0.026	0.003	0.003
%CF Fit	0.345*** [0.102]	0.418*** [0.098]	0.542*** [0.112]	0.505*** [0.100]	0.143 [0.098]	0.111 [0.092]
%CF Residuals	0.689*** [0.129]		0.264** [0.106]		0.077** [0.035]	
%CF Residuals Pos		0.782*** [0.112]		0.215** [0.107]		0.036* [0.019]
%CF Residuals Neg		-0.074 [0.107]		0.673*** [0.141]		0.415** [0.173]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Pension Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Reporting-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,230	3,230	3,230	3,230	3,217	3,217
R-squared	0.437	0.451	0.337	0.341	0.235	0.239
p-value test Pos = Neg		0.00		0.04		0.03

Equity Investment Flows by Alternative Terciles

- ▶ We redo regressions for pension funds in the bottom and top tercile of their alternative/risky allocations.
- ▶ The selling of equities is concentrated in the high tercile group, consistent with these funds having lower liquidity buffers.

	%Alternatives Low (1)	Terciles High (2)	%Risky Terciles Low (3)	High (4)
Mean Dep. Var.	-0.020	-0.025	-0.012	-0.035
%CF Fit	0.295 [0.311]	0.661** [0.288]	0.930** [0.359]	0.568*** [0.212]
%CF Residuals Pos	0.386*** [0.088]	0.166** [0.066]	0.359*** [0.120]	0.503*** [0.081]
%CF Residuals Neg	0.193 [0.232]	0.514*** [0.109]	0.326 [0.383]	0.507** [0.219]
Controls	Yes	Yes	Yes	Yes
Pension Fund FE	Yes	Yes	Yes	Yes
Year-Reporting-Month FE	Yes	Yes	Yes	Yes
Observations	961	1,128	981	1,099
R-squared	0.496	0.329	0.463	0.399
p-value test Pos = Neg	0.44	0.01	0.94	0.99

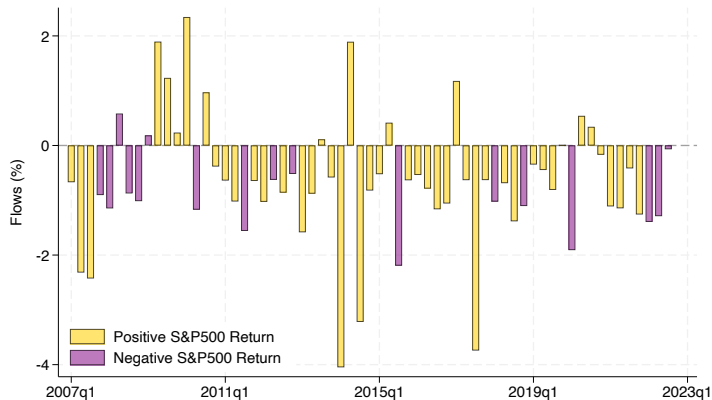
Equity Investment Flows and Rebalancing

- The selling of equities is distinct from rebalancing effects: pension funds also sell equities in response to cash flow shocks when equities **underperform** fixed income.

	Cash & FI		Equity		Alternatives	
	(1)	(2)	(3)	(4)	(5)	(6)
Subsample of Time Periods when $R_{EQ,t}^{BM} < R_{FI,t}^{BM}$						
Mean Dep. Var.	-0.019	-0.019	-0.013	-0.013	0.001	0.001
%CF Fit	0.490*** [0.143]	0.502*** [0.142]	0.422*** [0.129]	0.413*** [0.130]	-0.029 [0.138]	-0.034 [0.136]
%CF Residuals	0.902*** [0.064]		0.072 [0.054]		0.030 [0.024]	
%CF Residuals Pos		0.944*** [0.034]		0.042 [0.034]		0.013 [0.018]
%CF Residuals Neg		0.103 [0.188]		0.629*** [0.134]		0.364** [0.184]
Allocation Gap	0.353*** [0.041]	0.355*** [0.040]	0.287*** [0.048]	0.291*** [0.048]	0.263*** [0.040]	0.261*** [0.039]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Pension Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Reporting-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,229	1,229	1,229	1,229	1,225	1,225
R-squared	0.619	0.627	0.426	0.432	0.307	0.310

Equity Investment Flows and Equity Returns

- In every quarter following the GFC with negative stock market returns, pension funds sell equities.



Security-Level Equity Flows and Cash Flows

- ▶ The security-level holdings allow us to study what type of securities pension funds sell in response to cash flow shocks.
- ▶ We hypothesize that pension funds follow a liquid-asset-first approach **within** equities by primarily selling their most liquid stocks.
- ▶ We run the following regression:
$$Flow_{i,j,t} = \beta CF_{i,t} \times Illiquid_{j,t} + \delta CF_{i,t} + \Gamma X_{i,t-1} + \theta_{j,t} + PF_i + \epsilon_{i,j,t}$$
 where $Flow_{i,j,t}$ is now at the security j level and $Illiquid_{j,t}$ indicates the liquidity of stock j .
- ▶ We measure illiquidity by top tercile of Amihud measure (alternative: bottom tercile market cap).

Security-Level Equity Flows and Illiquid Stocks

- Pension funds are not less likely to sell illiquid stocks (consistent pro-rata approach).

Mean Dep. Var.	0.032 (1)	0.035 (2)	0.032 (3)	0.035 (4)
%CF Residuals	0.009*** [0.002]	0.012*** [0.002]		
%CF Residuals Pos			0.012*** [0.002]	0.014*** [0.003]
%CF Residuals Neg			-0.011 [0.006]	-0.005 [0.008]
%CF Residuals × Amihud High	-0.006** [0.002]	-0.006* [0.003]		
%CF Residuals Pos × Amihud High			-0.008*** [0.002]	-0.008*** [0.002]
%CF Residuals Neg × Amihud High			0.007 [0.010]	0.017 [0.014]
Amihud High	0.024*** [0.007]		0.028** [0.009]	
Controls	Yes	Yes	Yes	Yes
Pension Fund FE	Yes	Yes	Yes	Yes
Year FE	Yes		Yes	
Security-Year FE		Yes		Yes
Observations	1.51e+06	1.33e+06	1.51e+06	1.33e+06
R-squared	0.004	0.242	0.004	0.242

Conclusion

- ▶ U.S. public pension funds have persistent negative net operating cash flows.
- ▶ Despite predictable outflows, target allocations are independent of cash flows and liquidity buffers are small.
- ▶ **Predictable outflows**: met via pro-rata sales tilted toward fixed income and equities.
- ▶ **Negative cash-flow shocks**: absorbed mainly through equity sales.
- ▶ **Within equities**: pension funds draw on both their liquid and illiquid equity holdings, especially those high in alternatives.

Key Takeaways

1. **Liquidity demand from long-term investors:** Negative cash flows limit pension funds' ability to act as market stabilizers in downturns.
2. **Spillovers:** Liquidity needs may transmit via external asset managers and commingled vehicles, affecting other institutional investors.
3. **Systemic risks:** As funds enter decumulation, cash outflows can introduce fragility in capital markets.

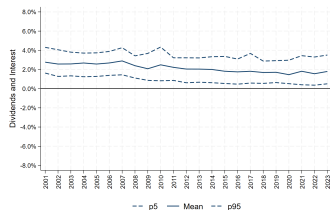
Pension Fund Summary Statistics

Main

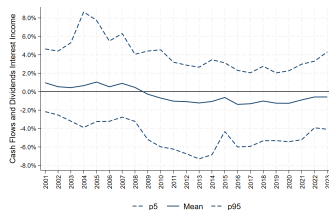
	N	Full Sample			N	FOIA Subsample		
		Mean	Median	SD		Mean	Median	SD
Panel A: Cash Flows								
%CF	4,083	-2.4	-2.3	3.3	728	-2.2	-2.0	2.7
%CF Fit	4,083	-2.5	-2.4	2.2	728	-2.4	-2.0	2.0
%CF Residuals	4,083	0.2	-0.0	2.8	728	0.2	-0.0	2.3
%CF Predicted	2,222	-2.8	-2.5	2.6	573	-2.5	-2.1	2.4
%CF Shock	2,222	0.1	-0.0	1.8	573	0.2	-0.0	1.7
Panel B: Pension Fund Characteristics								
Pension Fund AUM (\$ bil)	4,083	18.3	5.0	36.5	728	29.4	11.0	54.9
GASB Funding Status	4,035	78.0	78.3	16.8	727	76.8	77.5	16.2
Return	4,083	6.5	8.1	10.9	728	7.4	8.0	10.4
Panel C: Target Asset Allocation								
%Cash & FI	3,496	25.9	25.7	7.1	692	25.2	25.0	7.0
%Cash	3,496	0.3	0.0	2.4	692	0.5	0.0	1.7
%Fixed Income	3,496	25.6	25.0	7.4	692	24.7	25.0	7.0
%Risky	3,496	74.1	74.3	7.1	692	74.8	75.0	7.0
%Equity	3,496	50.5	51.0	10.6	692	48.5	48.0	11.3
%Alternatives	3,496	23.6	23.4	13.1	692	26.3	26.6	13.3
%Private Equity	3,496	6.9	6.9	6.0	692	7.7	8.0	6.5
%Real Assets	3,496	9.9	10.0	6.1	692	10.5	11.0	5.9
%Hedge Funds	3,496	4.9	0.0	6.7	692	6.0	4.0	7.1
%Other Alternatives	3,496	1.8	0.0	5.3	692	2.2	0.0	6.2

Pension Fund Cash Flows and Investment Income

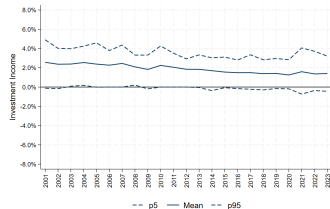
Main



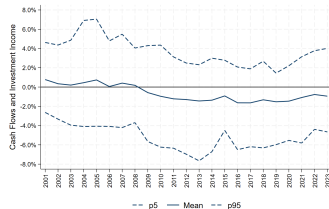
(a) Panel A: Dividends and Interest Income



(b) Panel B: Cash Flows and Div Int Income



(c) Panel C: Investment Income



(d) Panel D: Cash Flows and Investment Income

Summary Statistics Derivatives Data

Main

	Usage (%)	Contracts (#)			Gross Notional (\$)			Gross Notional (%)		
		Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Linear derivatives	71.2	106	31	178	1.0	0.0	3.7	2.6	0.0	5.0
Equity	53.3	11	4	22	0.0	0.0	0.6	0.1	0.0	0.5
Fixed Income	64.3	76	14	143	0.9	0.0	3.6	2.4	0.0	4.9
Currency	38.0	10	0	65	0.0	0.0	0.1	0.1	0.0	0.7
Other	25.5	9	0	32	0.0	0.0	0.3	0.1	0.0	0.3
Non-linear derivatives	72.9	26	7	42	0.3	0.0	2.3	0.5	0.0	3.8