

The Fragility Tax

How Mutual Fund Ownership Links Segmented Markets

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Motivation

Standard models predict segmented markets between municipal bonds and equities due to different clienteles and tax treatments

The puzzle: Why do municipal yields spike when the S&P 500 falls, even for issuers with stable fundamentals?

- The correlation between the two markets' returns is 0.09, but increases to 0.40 in months with the S&P 500 return in the bottom decile

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This paper identifies a structural **demand-side friction**:

Liquidity shocks to equity investors can transmit to the muni market through their investment in open-end mutual funds, which invest in illiquid bonds but offer daily liquidity to investors

Preview of results: the Fragility Tax

Ownership risk translates into a direct cost of capital for local governments:

14–25 basis points

The trading yield wedge for bonds held by fragile (i.e., more sensitive to **stock** market) funds

\$2.5 billion annual cost

Aggregate increase in municipal borrowing costs

\$4 billion investment loss

Forgone local infrastructure investment due to quantity rationing in issuance

Mechanism

Open-end fund fragility: Retail investors redeem during equity declines, forcing liquidation of illiquid muni bonds



Ownership structure of municipal debt and local public goods provision

- Poterba (1994); Poterba and Rueben (1999); Lorenzoni (2008); Dávila and Korinek (2018); etc.

Cross-market contagion through the portfolio (fund liability) channel

- Yuan (2005); Boyer, Kumagai, and Yuan (2006); Broner, Gelos, and Reinhart (2006); Chernenko and Sunderam (2012); Chodorow-Reich, Nenov, and Simsek (2021); etc.
- More broadly, intermediary asset pricing literature: He and Krishnamurthy (2013); Adrian, Etula, and Muir (2014); He, Kelly, and Manela (2017); Haddad and Muir (2021); etc.

Ownership structure of bonds and fragility of bond funds

- Kojen and Yogo (2023); Goldstein, Jiang, and Ng (2017); Falato, Goldstein, and Hortaçsu (2021); Falato et al. (2021); Jiang et al. (2022; Ma, Xiao, and Zeng (2022); etc.

Data

Estimating fund beta

For each fund, estimate its return beta using a 24-month rolling regression of the *excess fund return* on the *excess stock market return*:

$$R_{f,m} = \alpha + \beta \times R_m^{stock} + \varepsilon_{f,m} \quad (1)$$

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Further decomposition:

$$\beta = \frac{dR_{f,m}}{dR_m^{stock}} = \underbrace{\frac{\partial R_{f,m}}{\partial R_m^{stock}}}_{\text{Direct fund beta}} + \underbrace{\frac{\partial R_{f,m}}{\partial R_m^{muni}} \frac{dR_m^{muni}}{dR_m^{stock}}}_{\text{Indirect fund beta}} \quad (2)$$

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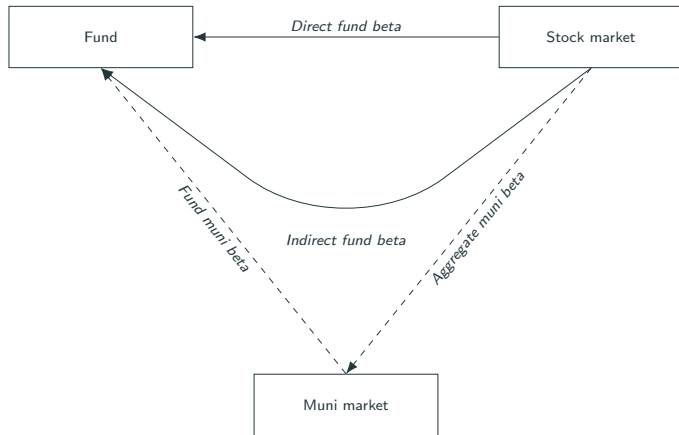
Estimating beta components:

$$R_{f,m} = \gamma + \beta_1 \times R_m^{stock} + \beta_2 \times R_m^{muni} + \varepsilon_{f,m}, \quad (3)$$

$$R_m^{muni} = \theta + \beta_{market} \times R_m^{stock} + \varepsilon_m \quad (4)$$

- Fund beta = β
- Direct fund beta = β_1
- Indirect fund beta = $\beta - \beta_1 = \beta_2 \times \beta_{market}$
- Fund muni beta = β_2
- Aggregate muni beta = β_{market}

Estimating fund beta



- **Municipal Securities Rulemaking Board (MSRB)**
 - All municipal bond transactions, excluding interdealer trades, from 2007 to 2021
- **Morningstar Direct Mutual Fund Database**
 - Mutual fund returns, flows, holdings, and other characteristics
- **Mergent Municipal Bond Database**
 - Municipal bond characteristics
- **Filters**
 - Bonds must be tax-exempt and either fixed-rate or zero-coupon
 - Exclude transactions occurring within the first three months after issuance and the last three months before maturity
 - Bonds must be held by at least one open-end muni fund in the month preceding the transaction

$$\text{Yield spread (bps)}_{b,t} = \alpha_{i,t} + \alpha_r + \beta \times \text{Fund beta}_{b,m-1} + \eta' X_{b,t} + \varepsilon_{b,t},$$

where b indexes bonds, i indexes issuers, r indexes ratings, m indexes year-months, and t indexes trading days

“Tax-adjusted” Yield spread

The difference between the yield, adjusted for federal and state taxes, and the maturity-matched Treasury yield on the same day

Bond-level fund beta

The par-weighted average fund beta across all funds holding the bond as of the previous month

Summary statistics [go](#)

Correlation of fund beta and components [go](#)

Yield spread and fund beta

Yield spread and fund beta

	(1)	(2)	(3)	(4)	(5)
Fund beta _{b,m-1}	25.338*** (2.082)				17.869*** (2.355)
Fund muni beta _{b,m-1}		28.423*** (0.952)			21.893*** (1.015)
Bond beta _{b,m-1}			1.571* (0.832)		2.460*** (0.705)
Bond muni beta _{b,m-1}				41.668*** (1.070)	39.276*** (1.001)
Ln(Par traded) _{b,t}	-12.464*** (0.221)	-12.311*** (0.216)	-14.962*** (0.323)	-14.466*** (0.308)	-14.275*** (0.302)
Mutual fund holding _{b,m-1}	6.682*** (0.619)	6.155*** (0.603)	6.683*** (1.121)	6.085*** (0.945)	5.267*** (0.902)
<i>N</i>	18,012,021	18,012,021	9,851,113	9,851,113	9,851,113
Adjusted <i>R</i> ²	0.77	0.78	0.77	0.78	0.79
Bond controls	✓	✓	✓	✓	✓
Issuer×Date FEs	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓

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⇒ yield spreads ↑ 25 bps

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Rating FEs	✓	✓	✓	✓	✓

- Fund beta ↑ 1 standard deviation
⇒ yield spreads ↑ 25 bps
- Similar when using other “beta” measures
- But Fund beta retains its significance when all measures are included

Fund beta components

	(1)	(2)	(3)	(4)	(5)
Direct fund beta $_{b,m-1}$	16.964*** (0.987)		17.213*** (0.947)		
Indirect fund beta $_{b,m-1}$		2.824 (2.484)	-4.603** (2.005)		
Fund muni beta $_{b,m-1}$				28.423*** (0.952)	
Aggregate muni beta $_{m-1}$					-13.670*** (2.539)
Ln(Par traded) $_{b,t}$	-12.429*** (0.220)	-12.532*** (0.221)	-12.429*** (0.220)	-12.311*** (0.216)	-14.285*** (0.229)
Mutual fund holding $_{b,m-1}$	6.657*** (0.612)	7.054*** (0.631)	6.685*** (0.612)	6.155*** (0.603)	7.788*** (0.569)
N	18,012,021	18,012,021	18,012,021	18,012,021	18,012,021
Adjusted R^2	0.77	0.77	0.77	0.78	0.70
Bond controls	✓	✓	✓	✓	
Issuer×Date FEs	✓	✓	✓	✓	
Issuer×Year-quarter FEs					✓
Rating FEs	✓	✓	✓	✓	✓

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Bond controls	✓	✓	✓	✓	
Issuer×Date FEs	✓	✓	✓	✓	
Issuer×Year-quarter FEs					✓
Rating FEs	✓	✓	✓	✓	✓

- Pricing wedge is driven by **direct** fund beta

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Issuer×Year-quarter FEs					✓
Rating FEs	✓	✓	✓	✓	✓

- Pricing wedge is driven by **direct** fund beta
- Negative loading on **indirect** fund beta due to the comovement of the two broad markets

Mechanism

Higher-beta funds experience larger future net outflows

<i>Dependent variable =</i>	Realized outflows (%)		Expected outflows (%)		Unexpected outflows (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
Fund $\text{beta}_{f,m-1}$	0.129*** (0.024)	0.117*** (0.024)	0.075*** (0.028)	0.065** (0.029)	0.060** (0.025)	0.056** (0.025)
Fund muni $\text{beta}_{f,m-1}$		0.042*** (0.016)		0.035* (0.019)		0.013 (0.017)
Net outflows $_{f,m-1}$	0.313*** (0.008)	0.313*** (0.008)	0.340*** (0.009)	0.340*** (0.009)	-0.038*** (0.007)	-0.038*** (0.007)
Net outflows $_{f,m-2}$	0.161*** (0.007)	0.161*** (0.007)	0.158*** (0.005)	0.158*** (0.005)	-0.002 (0.007)	-0.002 (0.007)
Net outflows $_{f,m-3}$	0.126*** (0.006)	0.126*** (0.006)	0.130*** (0.004)	0.130*** (0.004)	-0.003 (0.006)	-0.003 (0.006)
Fund return $_{f,m-1}$	-0.091*** (0.016)	-0.094*** (0.016)	-0.113*** (0.019)	-0.115*** (0.019)	0.025 (0.018)	0.024 (0.018)
Fund return $_{f,m-2}$	-0.006 (0.016)	-0.007 (0.016)	0.050*** (0.009)	0.049*** (0.009)	-0.057*** (0.017)	-0.058*** (0.017)
Fund return $_{f,m-3}$	0.006 (0.011)	0.004 (0.011)	0.057*** (0.008)	0.055*** (0.008)	-0.049*** (0.014)	-0.050*** (0.014)
<i>N</i>	93,345	93,345	93,345	93,345	93,345	93,345
Adjusted R^2	0.36	0.36	0.58	0.58	0.10	0.10
Dependent variable mean	-0.322	-0.322	-0.387	-0.387	0.068	0.068
Dependent variable SD	2.380	2.380	1.802	1.802	2.211	2.211
Fund controls	✓	✓	✓	✓	✓	✓
Year-month FEs	✓	✓	✓	✓	✓	✓

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⇒ High-beta funds may be forced to sell at a steep discount

Larger Fragility Tax when flow pressure is larger

	Realized flow pressure			Expected flow pressure		
	(1)	(2)	(3)	(4)	(5)	(6)
Fund $\text{beta}_{b,m-1}$		24.943*** (2.086)	25.914*** (2.125)		24.595*** (2.077)	25.535*** (2.115)
Fund $\text{beta}_{b,m-1} \times \text{Flow pressure}_{b,m}$		1.428*** (0.292)	1.157*** (0.312)		1.267*** (0.321)	0.816** (0.334)
Fund $\text{beta}_{b,m-1} \times \text{Flow pressure}_{b,m} \times \text{Sale}_{b,t}$			1.257*** (0.227)			1.462*** (0.224)
Fund $\text{beta}_{b,m-1} \times \text{Sale}_{b,t}$			-1.822*** (0.377)			-1.736*** (0.379)
Flow $\text{pressure}_{b,m} \times \text{Sale}_{b,t}$			3.172*** (0.278)			4.185*** (0.234)
Flow $\text{pressure}_{b,m}$	3.776*** (0.307)	3.272*** (0.288)	2.342*** (0.331)	6.407*** (0.371)	5.681*** (0.344)	4.331*** (0.368)
$\text{Sale}_{b,t}$			61.358*** (0.478)			61.399*** (0.479)
<i>N</i>			17,987,982			
Bond controls	✓	✓	✓	✓	✓	✓
Issuer $\times$ Date FEs	✓	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

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Issuer $\times$ Date FEs	✓	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

Flow pressure is the par-weighted average month- t (expected) net outflows across all funds holding the bond as of the previous month

Larger Fragility Tax

- when funds hold lower cash buffers [go](#)
- when funds belong to families with a larger share of equity funds [go](#)
- on mutual fund trades versus other investors' trades [go](#)
- when retail investors play a more important role [go](#)

Additional results:

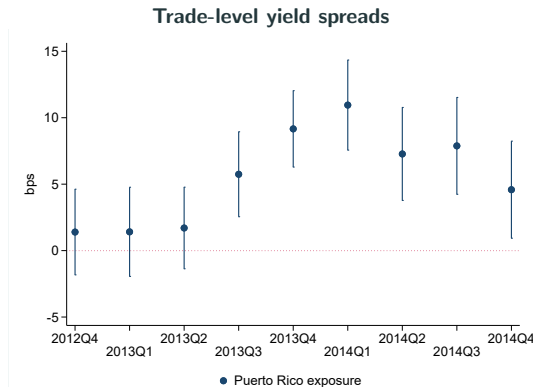
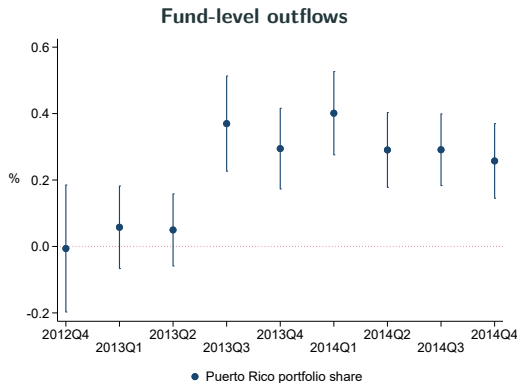
- Fragility Tax over time [go](#)
- Aggregate muni beta and fund flows [go](#)
- Robustness [go](#)

Identification

- Subsample analysis with fund identity [go](#)
- Open-end versus closed-end funds [go](#)
- Active ownership turnover [go](#)
- Matched bond sample analysis [go](#)
- Shift-share instrumental variable analysis [go](#)
- Puerto Rico debt crisis quasi experiment [go](#)

Exposure to Puerto Rico debt crisis

Bonds held by funds with larger exposure to Puerto Rico government debt crisis experience a spike in yields in 2013



Regression results [go](#)

[back](#)

Real economic consequences

Higher cost of local financing

Dependent variable =	Offering yield spread			Tax-adjusted offering yield spread		
	(1)	(2)	(3)	(4)	(5)	(6)
Fund $\beta_{i,m-1}$	6.075*** (0.853)	8.095*** (1.228)		10.370*** (1.422)	13.695*** (2.057)	
Direct fund $\beta_{i,m-1}$			4.060*** (0.535)			6.616*** (0.928)
Indirect fund $\beta_{i,m-1}$			1.505 (1.457)			3.448 (2.489)
Mutual fund holding $_{i,m-1}$	2.607*** (0.438)	2.880*** (0.514)	2.735*** (0.503)	4.626*** (0.789)	5.202*** (0.868)	4.980*** (0.852)
Negotiated sale _b	7.145*** (0.851)	5.918*** (0.855)	5.817*** (0.866)	11.816*** (1.425)	10.162*** (1.395)	10.007*** (1.408)
N	709,838	709,838	709,838	709,838	709,838	709,838
Adjusted R ²	0.74	0.82	0.82	0.80	0.86	0.86
Dependent variable mean	31.831	31.831	31.831	205.144	205.144	205.144
Dependent variable SD	62.679	62.679	62.679	123.369	123.369	123.369
Bond controls	✓	✓	✓	✓	✓	✓
County controls	✓			✓		
State×Year-month FEs	✓			✓		
County×Year-month FEs		✓	✓		✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

Higher cost of local financing

Dependent variable =

Offering yield spread

Tax-adjusted offering yield spread

	(1)	(2)	(3)	(4)	(5)	(6)
Fund beta _{<i>i,m-1</i>}	6.075*** (0.853)	8.095*** (1.228)		10.370*** (1.422)	13.695*** (2.057)	
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Mutual fund holding _{<i>i,m-1</i>}	2.607*** (0.438)	2.880*** (0.514)	2.735*** (0.503)	4.626*** (0.789)	5.202*** (0.868)	4.980*** (0.852)
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<i>N</i>	709,838	709,838	709,838	709,838	709,838	709,838
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Dependent variable mean	31.831	31.831	31.831	205.144	205.144	205.144
Dependent variable SD	62.679	62.679	62.679	123.369	123.369	123.369
Bond controls	✓	✓	✓	✓	✓	✓
County controls	✓			✓		
State×Year-month FEs	✓			✓		
County×Year-month FEs		✓	✓		✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

- Average fund beta ↑ 1 std
⇒ yield spreads ↑ 6–14 bps
- Driven by **direct** fund beta
- Aggregate annual cost ↑ \$2.5 billion

Quantity rationing

Dependent variable =	Issuance amount per capita (\$)		Issuance amount/GDP (\$ per \$1,000 GDP)	
	(1)	(2)	(3)	(4)
Fund $\beta_{c,y-1}$	-33.644*** (9.952)		-0.817*** (0.244)	
Direct fund $\beta_{c,y-1}$		-26.650*** (6.439)		-0.566*** (0.152)
Indirect fund $\beta_{c,y-1}$		24.919 (17.735)		0.263 (0.376)
Mutual fund holding $\beta_{c,y-1}$	33.468* (16.905)	35.489** (16.811)	0.641* (0.320)	0.676** (0.318)
$\ln(\text{Outstanding debt})_{c,y-1}$	686.540*** (82.153)	686.123*** (82.202)	13.413*** (1.529)	13.405*** (1.529)
<i>N</i>	23,750	23,750	23,750	23,750
Adjusted R^2	0.25	0.25	0.18	0.18
Dependent variable mean	551.144	551.144	12.628	12.628
Dependent variable SD	900.307	900.307	18.466	18.466
County controls	✓	✓	✓	✓
State×Year FEs	✓	✓	✓	✓

Quantity rationing

Dependent variable =	Issuance amount per capita (\$)		Issuance amount/GDP (\$ per \$1,000 GDP)	
	(1)	(2)	(3)	(4)
Fund beta _{c,y-1}	-33.644*** (9.952)		-0.817*** (0.244)	
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Mutual fund holding _{c,y-1}	33.468* (16.905)	35.489** (16.811)	0.641* (0.320)	0.676** (0.318)
Ln(Outstanding debt) _{c,y-1}	686.540*** (82.153)	686.123*** (82.202)	13.413*** (1.529)	13.405*** (1.529)
N	23,750	23,750	23,750	23,750
Adjusted R ²	0.25	0.25	0.18	0.18
Dependent variable mean	551.144	551.144	12.628	12.628
Dependent variable SD	900.307	900.307	18.466	18.466
County controls	✓	✓	✓	✓
State×Year FEs	✓	✓	✓	✓

- Average fund beta ↑ 1 std
⇒ issuance per capita ↓ \$34
- Driven by **direct** fund beta
- Aggregate annual issuance ↓ \$4 billion

Conclusion

- The Fragility Tax: Municipal bonds held by high *stock market beta* funds exhibit higher yield spreads of up to 25 basis points
- Mechanism—**Fragile holders**:
 - When equity markets decline, retail investors liquidate across their portfolios
 - The open-end fund's daily redemption right forces managers to liquidate illiquid bonds at steep discounts
 - Markets anticipate this, embedding expected fire-sale costs into yields even before any selling occurs
- Spillover to the primary market: higher borrowing costs and lower issuance amounts
- Solutions? Liquidity buffers and swing pricing may help reduce fragility risk

Appendix

Summary statistics

				Percentile		
	N	Mean	SD	25th	50th	75th
Explanatory variables						
Fund beta	18,012,021	0.01	0.09	-0.05	-0.00	0.06
Direct fund beta	18,012,021	0.01	0.03	-0.00	0.01	0.02
Indirect fund beta	18,012,021	-0.00	0.07	-0.06	-0.01	0.05
Fund muni beta	18,012,021	0.97	0.31	0.84	0.98	1.13
Bond beta	10,109,187	0.01	0.18	-0.08	0.01	0.10
Bond muni beta	10,109,187	0.90	0.74	0.34	0.83	1.34
Aggregate muni beta	18,012,021	-0.01	0.07	-0.07	-0.01	0.05
Bond characteristics						
Yield (bps)	18,012,021	305.64	173.59	159.20	290.00	449.90
Yield spread, not tax-adjusted (bps)	18,012,021	44.04	124.70	-32.35	30.05	106.24
Yield spread (bps)	18,012,021	255.70	222.61	87.80	228.35	398.05
Bond sale	18,012,021	0.36	0.48	0.00	0.00	1.00
Par traded (\$m)	18,012,021	0.23	1.87	0.01	0.03	0.07
Mutual fund holding (%)	18,012,021	29.98	26.72	10.20	23.77	42.70
# holding funds	18,012,021	3.83	5.61	1.00	2.00	4.00
Flow pressure	17,989,520	-0.12	8.35	-0.31	-0.06	0.06
Cash (%)	18,011,039	1.03	1.74	0.00	0.44	1.29
Family's equity fund share	18,012,006	0.56	0.14	0.48	0.58	0.67
Retail share	18,005,114	0.81	0.26	0.73	0.93	1.00
Offering amount (\$m)	18,012,021	89.18	235.80	15.27	37.26	87.78
Callable bond	18,012,021	0.75	0.43	0.00	1.00	1.00
General obligation bond	18,012,021	0.21	0.41	0.00	0.00	0.00
Insured bond	18,012,021	0.26	0.44	0.00	0.00	1.00
Credit-enhanced bond	18,012,021	0.04	0.21	0.00	0.00	0.00
Bank-qualified bond	18,012,021	0.00	0.05	0.00	0.00	0.00
Bond age (years)	18,012,021	4.92	3.93	1.91	4.18	7.02
Bond maturity (years)	18,012,021	15.39	9.32	7.21	15.18	22.99
Bond turnover (%)	18,012,021	4.86	11.69	0.12	0.73	3.11
Bond rating	16,898,097	3.60	2.58	2.00	3.00	5.00
Market conditions						
Sentiment	18,012,021	81.45	12.45	72.30	81.20	93.40
DOX	14,157,413	0.47	0.20	0.29	0.48	0.60
Market markup (%)	18,012,021	0.88	0.30	0.64	0.85	1.09
VIX	18,012,021	20.75	10.67	13.90	17.58	23.47
Aggregate net outflows (%)	16,028,212	-0.01	0.08	-0.05	-0.02	0.01

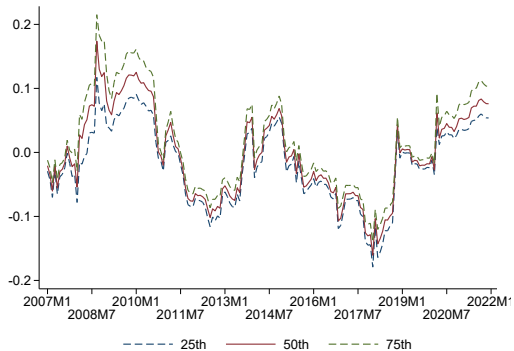
Fund beta correlation

	Fund beta	Direct fund beta	Indirect fund beta	Fund muni beta	Aggregate muni beta	Mutual fund holding	Fund return	Flow pressure
Fund beta	1.00	0.59	0.93	0.22	0.88	0.03	-0.04	-0.06
Direct fund beta	0.59	1.00	0.25	0.35	0.21	0.07	-0.12	0.01
Indirect fund beta	0.93	0.25	1.00	0.11	0.96	0.00	0.00	-0.07
Fund muni beta	0.22	0.35	0.11	1.00	0.09	0.10	0.17	0.06
Aggregate muni beta	0.88	0.21	0.96	0.09	1.00	0.00	-0.01	-0.09
Mutual fund holding	0.03	0.07	0.00	0.10	0.00	1.00	0.02	-0.11
Fund return	-0.04	-0.12	0.00	0.17	-0.01	0.02	1.00	-0.16
Flow pressure	-0.06	0.01	-0.07	0.06	-0.09	-0.11	-0.16	1.00

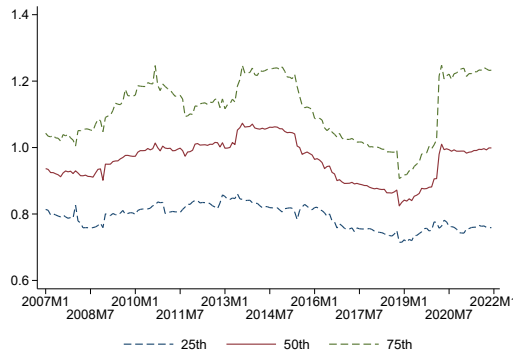
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Fund beta over time

Fund "stock" beta



Fund muni beta



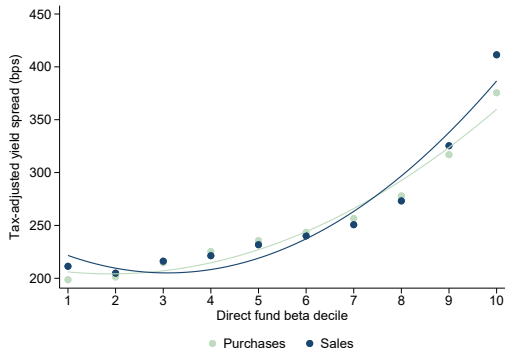
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Fund beta determinants

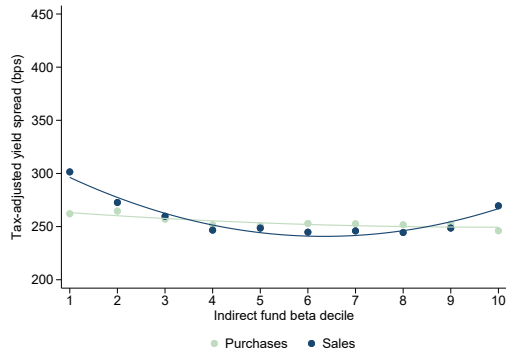
Dependent variable =	Fund beta	Direct fund beta	Indirect fund beta	Fund muni beta
	(1)	(2)	(3)	(4)
Net outflows $_{t,n-12, \rightarrow n-1}$	0.028*** (0.006)	0.011 (0.008)	0.028*** (0.005)	0.018*** (0.005)
Fund return $_{t,n-12, \rightarrow n-1}$	-0.490*** (0.026)	-1.053*** (0.049)	-0.063*** (0.013)	0.281*** (0.021)
Ln(Fund TNA) $_{t,n-1}$	-0.000 (0.012)	0.008 (0.023)	-0.005 (0.005)	-0.039* (0.022)
Ln(Family TNA) $_{t,n-1}$	0.011 (0.010)	0.009 (0.020)	0.009** (0.004)	-0.006 (0.019)
Fund age $_{t,n-1}$	-0.038*** (0.009)	-0.085*** (0.019)	-0.003 (0.003)	-0.022 (0.014)
Retail share $_{t,n-1}$	0.011 (0.008)	0.015 (0.015)	0.006* (0.003)	-0.023* (0.013)
Short-term fund $_t$	0.055 (0.045)	0.098 (0.068)	0.018 (0.017)	-0.821*** (0.073)
Single-state fund $_t$	-0.007 (0.020)	-0.031 (0.041)	0.007 (0.008)	0.002 (0.042)
Index fund $_t$	-0.063 (0.043)	-0.331*** (0.083)	0.089** (0.035)	-0.076 (0.108)
Cash/TNA $_{t,n-1}$	-0.025** (0.011)	-0.074*** (0.021)	0.006 (0.007)	-0.291*** (0.019)
Management fee $_t$	-0.016* (0.009)	-0.033** (0.016)	-0.002 (0.004)	-0.037*** (0.014)
Portfolio HH $_{t,n-1}$	-0.002 (0.008)	0.008 (0.016)	-0.007** (0.003)	-0.021* (0.011)
Ln(Portfolio offering amount) $_{t,n-1}$	0.009 (0.011)	0.018 (0.022)	0.002 (0.005)	-0.000 (0.019)
Ln(Portfolio bond age) $_{t,n-1}$	-0.037*** (0.010)	-0.035* (0.018)	-0.027*** (0.006)	-0.134*** (0.016)
Ln(Portfolio bond maturity) $_{t,n-1}$	0.121*** (0.022)	0.254*** (0.040)	0.018* (0.010)	0.590*** (0.040)
Portfolio callable bond share $_{t,n-1}$	-0.054*** (0.018)	-0.059* (0.034)	-0.035*** (0.009)	-0.174*** (0.031)
Portfolio GO bond share $_{t,n-1}$	-0.001 (0.009)	0.012 (0.017)	-0.007* (0.004)	0.026 (0.017)
Portfolio insured bond share $_{t,n-1}$	-0.053*** (0.013)	-0.157*** (0.025)	0.015*** (0.006)	0.056*** (0.020)
Portfolio credit-enhanced bond share $_{t,n-1}$	-0.021*** (0.008)	-0.029* (0.015)	-0.010*** (0.004)	-0.040*** (0.015)
Portfolio bank-qualified bond share $_{t,n-1}$	0.003 (0.011)	-0.003 (0.022)	0.005 (0.004)	-0.042** (0.019)
Portfolio rated bond share $_{t,n-1}$	-0.136*** (0.019)	-0.255*** (0.039)	-0.036*** (0.007)	-0.034 (0.039)
Portfolio bond rating $_{t,n-1}$	0.111*** (0.012)	0.253*** (0.026)	0.007 (0.005)	0.161*** (0.021)
N	93,345	93,345	93,345	93,345
Adjusted R ²	0.80	0.36	0.90	0.69
Year-month FEs	✓	✓	✓	✓

Purchases versus sales

Direct fund beta

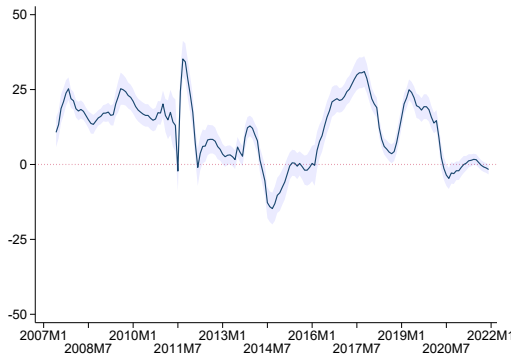


Indirect fund beta

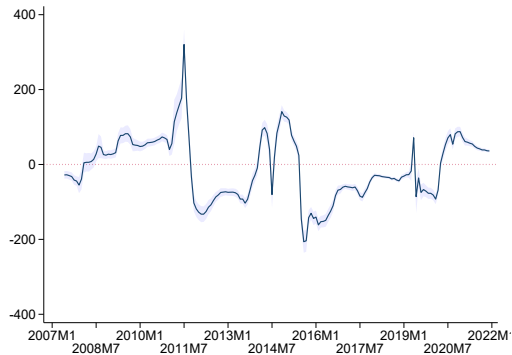


Fund beta effect over time

Direct fund beta



Indirect fund beta



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Aggregate muni beta and net outflows

<i>Dependent variable =</i>	Realized outflows		Expected outflows		Unexpected outflows	
	(1)	(2)	(3)	(4)	(5)	(6)
Aggregate muni beta $_{f,m-1}$	-0.091*** (0.007)	-0.442*** (0.034)	-0.058*** (0.009)	-0.208*** (0.021)	-0.035*** (0.009)	-0.214*** (0.038)
Net outflows $_{f,m-1}$	0.322*** (0.008)	0.310*** (0.008)	0.335*** (0.009)	0.340*** (0.009)	-0.025*** (0.006)	-0.042*** (0.007)
Net outflows $_{f,m-2}$	0.164*** (0.007)	0.163*** (0.006)	0.150*** (0.005)	0.155*** (0.005)	0.010 (0.007)	0.004 (0.006)
Net outflows $_{f,m-3}$	0.119*** (0.006)	0.130*** (0.006)	0.128*** (0.004)	0.136*** (0.004)	-0.008 (0.006)	-0.004 (0.006)
Fund return $_{f,m-1}$	-0.178*** (0.008)	-0.107*** (0.009)	-0.149*** (0.009)	-0.144*** (0.009)	-0.029*** (0.007)	0.039*** (0.009)
Fund return $_{f,m-2}$	-0.003 (0.007)	0.055*** (0.008)	0.037*** (0.004)	0.036*** (0.005)	-0.041*** (0.007)	0.020** (0.008)
Fund return $_{f,m-3}$	-0.011** (0.005)	0.029*** (0.006)	0.047*** (0.003)	0.030*** (0.004)	-0.058*** (0.006)	0.000 (0.007)
<i>N</i>	93,345	93,345	93,345	93,345	93,345	93,345
Adjusted R^2	0.30	0.33	0.56	0.57	0.01	0.06
Dependent variable mean	-0.322	-0.322	-0.387	-0.387	0.068	0.068
Dependent variable SD	2.380	2.380	1.802	1.802	2.211	2.211
Fund controls	✓	✓	✓	✓	✓	✓
Quarter-month FEs		✓		✓		✓

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Larger Fragility Tax when funds have lower cash buffers

			High VIX	Low VIX
	(1)	(2)	(3)	(5)
Fund $\text{beta}_{b,m-1}$	24.932*** (2.060)		34.705*** (2.205)	2.417 (2.353)
Fund $\text{beta}_{b,m-1} \times \text{Cash}_{b,m-1}$	-2.156*** (0.375)		-2.741*** (0.516)	-0.468 (0.400)
Direct fund $\text{beta}_{b,m-1}$		16.987*** (0.932)		
Indirect fund $\text{beta}_{b,m-1}$		-5.231*** (1.980)		
Direct fund $\text{beta}_{b,m-1} \times \text{Cash}_{b,m-1}$		-2.924*** (0.368)		
Indirect fund $\text{beta}_{b,m-1} \times \text{Cash}_{b,m-1}$		-0.950*** (0.316)		
Cash $_{b,m-1}$	-1.250*** (0.321)	-1.821*** (0.323)	-0.522 (0.393)	-1.166*** (0.364)
N	18,010,967	18,010,967	9,004,475	9,006,492
Adjusted R^2	0.77	0.77	0.79	0.75
Bond controls	✓	✓	✓	✓
Issuer×Date FEs	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓

Larger Fragility Tax when funds belong to high-equity-share families

			High VIX	Low VIX
	(1)	(2)	(3)	(4)
Fund $\text{beta}_{b,m-1}$	25.886*** (2.088)		36.109*** (2.224)	2.474 (2.369)
Fund $\text{beta}_{b,m-1} \times \text{Family's equity fund share}_{b,m-1}$	1.238*** (0.399)		2.126*** (0.535)	-0.566 (0.361)
Direct fund $\text{beta}_{b,m-1}$		17.753*** (0.952)		
Indirect fund $\text{beta}_{b,m-1}$		-4.510** (1.999)		
Direct fund $\text{beta}_{b,m-1} \times \text{Family's equity fund share}_{b,m-1}$		1.730*** (0.469)		
Indirect fund $\text{beta}_{b,m-1} \times \text{Family's equity fund share}_{b,m-1}$		0.689* (0.364)		
Family's equity fund share $_{b,m-1}$	2.176*** (0.444)	2.774*** (0.458)	2.844*** (0.510)	0.418 (0.477)
N	18,012,004	18,012,004	9,005,356	9,006,648
Adjusted R^2	0.77	0.77	0.79	0.75
Bond controls	✓	✓	✓	✓
Issuer $\times$ Date FEs	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓

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Larger Fragility Tax on mutual fund trades, particularly sales

	(1)	(2)	(3)	(4)	(5)	(6)
Fund $\text{beta}_{b,m-1}$		25.238*** (2.085)	26.427*** (2.123)			
Fund $\text{beta}_{b,m-1} \times \text{Fund trade}_{b,t}$		5.518*** (0.563)	3.719*** (0.736)		3.267*** (0.322)	-0.111 (0.455)
Fund $\text{beta}_{b,m-1} \times \text{Fund trade}_{b,t} \times \text{Sale}_{b,t}$			1.822** (0.765)			3.869*** (0.540)
Fund $\text{beta}_{b,m-1} \times \text{Sale}_{b,t}$			-2.309*** (0.398)			-0.976*** (0.363)
Fund $\text{trade}_{b,t} \times \text{Sale}_{b,t}$			-49.732*** (0.833)			-55.969*** (0.723)
Fund $\text{trade}_{b,t}$	14.603*** (0.573)	15.080*** (0.573)	32.641*** (0.722)	6.687*** (0.361)	6.805*** (0.357)	26.171*** (0.534)
Sale $_{b,t}$			62.526*** (0.498)			62.774*** (0.518)
<i>N</i>	18,012,021	18,012,021	18,012,021	13,227,840	13,227,840	13,227,840
Adjusted R^2	0.77	0.77	0.79	0.93	0.93	0.94
Bond controls	✓	✓	✓			
Issuer $\times$ Date FEs	✓	✓	✓			
Bond $\times$ Date FEs				✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

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Larger Fragility Tax when retail investors play a more important roles

	(1)	(2)	(3)	(4)
Fund beta _{<i>b,m-1</i>}	25.140*** (2.040)		12.273*** (1.661)	27.197*** (2.170)
Fund beta _{<i>b,m-1</i>} × Retail share _{<i>b,m-1</i>}	1.912*** (0.418)			
Direct fund beta _{<i>b,m-1</i>}		17.209*** (0.938)		
Indirect fund beta _{<i>b,m-1</i>}		-5.455*** (1.949)		
Direct fund beta _{<i>b,m-1</i>} × Retail share _{<i>b,m-1</i>}		3.384*** (0.526)		
Indirect fund beta _{<i>b,m-1</i>} × Retail share _{<i>b,m-1</i>}		0.775** (0.372)		
Fund beta _{<i>b,m-1</i>} × Sentiment _{<i>m</i>}			-19.683*** (1.254)	
Fund beta _{<i>b,m-1</i>} × DOX _{<i>m</i>}				6.893*** (1.649)
Retail share _{<i>b,m-1</i>}	2.780*** (0.423)	3.374*** (0.439)		
<i>N</i>	18,004,526	18,004,526	18,012,021	14,157,413
Adjusted <i>R</i> ²	0.77	0.77	0.77	0.76
Bond controls	✓	✓	✓	✓
Issuer × Date FEs	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓

Subsample analysis with fund identity

	(1)	(2)	(3)	(4)	(5)	(6)
Fund beta _{b,m-1}	74.132*** (3.281)	38.602*** (2.454)	22.320*** (2.793)	13.746*** (2.958)		11.594*** (2.678)
Fund beta _{f,m-1}					11.063*** (1.683)	6.589*** (1.633)
Ln(Par traded) _{b,t}	-0.479 (1.265)	-3.493*** (1.080)	-5.065*** (0.898)	-7.082*** (0.727)	-6.082*** (0.772)	-6.090*** (0.771)
Net outflows _{f,t}	-0.375 (1.323)	0.855 (1.218)	2.654* (1.483)	2.757*** (0.953)	4.563*** (0.852)	4.557*** (0.851)
Ln(Fund TNA) _{f,m-1}					-10.564*** (1.764)	-10.463*** (1.762)
Ln(Family TNA) _{f,m-1}					-0.100 (1.705)	0.076 (1.705)
Mutual fund holding _{b,m-1}		18.484*** (1.005)	13.154*** (1.436)	-1.936 (1.240)	-0.656 (1.293)	-0.834 (1.295)
N	215,504	215,504	146,169	167,875	169,510	169,510
Adjusted R ²	0.55	0.65	0.87	0.85	0.82	0.82
Bond controls	✓	✓	✓	✓	✓	✓
Fund FEs					✓	✓
Year-month FEs					✓	✓
Fund×Year-month FEs	✓	✓	✓	✓		
Issuer×Year-month FEs			✓			
Bond FEs				✓	✓	✓
Rating FEs		✓	✓	✓	✓	✓

Open-end funds exhibit stronger effects than closed-end funds

	(1)	(2)	(3)	(4)	(5)	(6)
Fund $\beta_{b,m-1}$	55.649*** (6.156)				53.271*** (5.825)	
Closed-end fund $\beta_{b,m-1}$			27.795*** (6.302)		16.133*** (4.711)	
Direct fund $\beta_{b,m-1}$		25.638*** (2.319)				24.597*** (2.208)
Indirect fund $\beta_{b,m-1}$		18.619** (7.881)				17.825** (7.681)
Direct closed-end fund $\beta_{b,m-1}$				12.686*** (2.397)		8.423*** (1.989)
Indirect closed-end fund $\beta_{b,m-1}$				13.083** (6.405)		6.083 (4.975)
$\ln(\text{Par traded})_{b,t}$	-5.769*** (0.407)	-5.751*** (0.406)	-5.606*** (0.421)	-5.594*** (0.421)	-5.835*** (0.405)	-5.804*** (0.404)
Mutual fund holding $_{b,m-1}$	5.927*** (1.435)	5.878*** (1.426)			5.833*** (1.430)	5.785*** (1.423)
Closed-end fund holding $_{b,m-1}$			4.226*** (1.119)	4.111*** (1.123)	3.843*** (1.111)	3.648*** (1.113)
<i>N</i>	4,517,676	4,517,676	4,517,676	4,517,676	4,517,676	4,517,676
Adjusted R^2	0.83	0.83	0.83	0.83	0.83	0.83
Bond controls	✓	✓	✓	✓	✓	✓
Issuer×Date FEs	✓	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

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Active ownership turnover

	(1)	(2)
Active $\beta_{b,m-1}$	3.183*** (0.288)	0.744*** (0.214)
Passive $\beta_{b,m-1}$	2.401* (1.274)	0.522 (0.851)
Cross-term $\beta_{b,m-1}$	0.132 (0.254)	-0.056 (0.201)
Fund $\beta_{b,m-2}$	26.064*** (2.141)	8.444*** (1.532)
$\text{Ln}(\text{Par traded})_{b,t}$	-12.458*** (0.221)	-10.476*** (0.186)
Mutual fund holding $_{b,m-1}$	6.687*** (0.620)	-1.020 (0.914)
N	18,010,867	18,005,727
Adjusted R^2	0.77	0.77
Bond controls	✓	✓
Issuer×Date FEs	✓	
Bond FEs		✓
Date FEs		✓
Rating FEs	✓	✓

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Matched bond sample analysis

	(1)	(2)	(3)	(4)
Fund beta _{b,m-1}	26.918*** (1.454)		14.124*** (0.962)	
Direct fund beta _{b,m-1}		26.869*** (0.847)		10.086*** (0.445)
Indirect fund beta _{b,m-1}		13.368*** (1.459)		-3.122** (1.220)
Ln(Par traded) _{b,t}	-16.474*** (0.992)	-16.908*** (0.992)	-6.326*** (0.181)	-6.327*** (0.181)
Mutual fund holding _{b,m-1}	21.815*** (1.314)	20.866*** (1.303)	3.906*** (0.683)	3.811*** (0.673)
Ln(Offering amount) _b	37.843*** (1.972)	36.006*** (1.901)	1.298 (1.034)	1.140 (1.032)
Ln(Bond age) _{b,t}	-46.485*** (1.791)	-44.883*** (1.712)	-18.693*** (0.708)	-18.479*** (0.705)
Ln(Bond maturity) _{b,t}	76.241*** (1.658)	75.155*** (1.616)	6.946*** (0.567)	6.656*** (0.557)
Bond turnover _{b,m-1}	10.324*** (0.515)	9.829*** (0.514)	-0.532*** (0.138)	-0.558*** (0.139)
N	17,907,825	17,907,825	17,888,513	17,888,513
Adjusted R ²	0.56	0.57	0.84	0.84
Matched group×Date FEs	✓	✓	✓	✓
Issuer×Date FEs			✓	✓

Shift-share instrumental variable analysis

Bond-level *Fund beta* is instrumented with shift-share *Fund beta*, which is estimated based on fund-level beta as of month $m - 1$ and fund holdings as of month $m - 13$

Dependent variable =	OLS	IV	
	Yield spread	First-stage	Second-stage
		Fund beta	Yield spread
	(1)	(2)	(3)
Fund beta (shift-share) $_{b,m-1}$	25.790*** (2.165)	0.841*** (0.008)	
$\widehat{\text{Fund beta}}_{b,m-1}$			30.684*** (2.545)
Ln(Par traded) $_{b,t}$	-14.421*** (0.253)	-0.001*** (0.000)	-14.402*** (0.253)
Mutual fund holding $_{b,m-1}$	7.636*** (0.700)	0.007*** (0.001)	7.414*** (0.696)
<i>N</i>	14,514,798	14,514,798	14,514,798
Adjusted R^2	0.78	0.98	0.08
Weak identification F statistic			11,315.95
Bond controls	✓	✓	✓
Issuer×Date FEs	✓	✓	✓
Rating FEs	✓	✓	✓

Exposure to Puerto Rico debt crisis

Sample	Fund-month level		Trade level
	Fund beta (standardized)	Net outflows (%)	Yield spread (bps)
	Puerto Rico portfolio share		Puerto Rico exposure
	(1)	(2)	(3)
Explanatory variable			
$\times 1(t \in 2012Q4)$	-0.018* (0.010)	-0.006 (0.097)	1.397 (1.641)
$\times 1(t \in 2013Q1)$	-0.003 (0.011)	0.058 (0.063)	1.411 (1.708)
$\times 1(t \in 2013Q2)$	-0.004 (0.011)	0.050 (0.055)	1.701 (1.563)
$\times 1(t \in 2013Q3)$	0.054*** (0.015)	0.370*** (0.073)	5.745*** (1.627)
$\times 1(t \in 2013Q4)$	0.142*** (0.035)	0.295*** (0.062)	9.161*** (1.463)
$\times 1(t \in 2014Q1)$	0.123*** (0.019)	0.401*** (0.064)	10.952*** (1.726)
$\times 1(t \in 2014Q2)$	0.195*** (0.024)	0.291*** (0.057)	7.273*** (1.781)
$\times 1(t \in 2014Q3)$	0.241*** (0.024)	0.291*** (0.055)	7.881*** (1.855)
$\times 1(t \in 2014Q4)$	0.223*** (0.025)	0.257*** (0.057)	4.584** (1.859)
<i>N</i>	13,406	13,406	2,271,241
Adjusted R^2	0.91	0.31	0.74
Dependent variable mean	-0.000	0.221	283.857
Dependent variable SD	1.000	2.194	231.105
Fund controls	✓	✓	
Bond controls			✓
Year-month FEs	✓	✓	
Issuer×Date FEs			✓
Rating FEs			✓

Stronger results on riskier bonds

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fund beta _{b,m-1}	15.488*** (1.715)	28.619*** (1.883)	25.578*** (2.077)	19.216*** (1.596)	0.317 (1.349)	5.847*** (1.320)	8.099*** (1.444)	-1.152 (1.226)
Fund beta _{b,m-1} × Bond rating _{b,t}	10.575*** (1.188)			10.777*** (1.199)	6.526*** (0.595)			6.356*** (0.584)
Fund beta _{b,m-1} × Ln(Bond maturity) _{b,t}		-4.560*** (0.802)		-5.071*** (0.736)		2.119*** (0.650)		1.796*** (0.622)
Fund beta _{b,m-1} × Bond turnover _{b,m-1}			-2.079*** (0.250)	-1.117*** (0.235)			-1.595*** (0.184)	-1.263*** (0.186)
Ln(Bond maturity) _{b,t}	29.188*** (1.083)	27.485*** (1.081)	28.050*** (1.070)	28.538*** (1.093)	-69.812*** (1.332)	-66.594*** (1.344)	-66.896*** (1.327)	-69.458*** (1.349)
Bond turnover _{b,m-1}	2.118*** (0.232)	1.439*** (0.241)	1.391*** (0.240)	2.046*** (0.232)	-1.626*** (0.234)	-1.613*** (0.229)	-1.506*** (0.223)	-1.548*** (0.231)
N	16,862,675	18,012,021	18,012,021	16,862,675	16,893,436	18,006,826	18,006,826	16,893,436
Adjusted R ²	0.78	0.77	0.77	0.78	0.77	0.77	0.77	0.77
Bond controls	✓	✓	✓	✓	✓	✓	✓	✓
Issuer×Date FEs	✓	✓	✓	✓				
Bond FEs					✓	✓	✓	✓
Date FEs					✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓	✓	✓

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Stronger results during stressed markets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fund $\text{beta}_{b,m-1}$	14.205*** (1.667)	21.152*** (2.105)	23.285*** (2.313)	13.931*** (1.849)	4.304*** (1.404)	6.749*** (1.580)	3.800*** (1.259)	4.626*** (1.251)
Fund $\text{beta}_{b,m-1} \times \text{Market markup}_t$	18.718*** (1.425)			21.311*** (2.087)	4.844*** (0.822)			-2.504*** (0.684)
Fund $\text{beta}_{b,m-1} \times \text{VIX}_t$		7.186*** (0.855)		6.357*** (1.725)		1.632*** (0.550)		1.783** (0.907)
Fund $\text{beta}_{b,m-1} \times \text{Aggregate net outflows}_t$			-7.844*** (1.971)	-3.221* (1.676)			3.586*** (1.091)	3.406*** (1.065)
<i>N</i>	18,012,021	18,012,021	16,028,212	16,028,212	18,006,826	18,006,826	16,023,394	16,023,394
Adjusted R^2	0.77	0.77	0.77	0.77	0.77	0.77	0.79	0.79
Bond controls	✓	✓	✓	✓	✓	✓	✓	✓
Issuer $\times$ Date FEs	✓	✓	✓	✓				
Bond FEs					✓	✓	✓	✓
Date FEs					✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓	✓	✓

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	N	Main explanatory variable		
		Fund beta	Direct fund beta	Indirect fund beta
(1) Baseline	18,012,021	25.338*** (2.082)	17.213*** (0.947)	-4.603** (2.005)
(2) Mergent-based issuer identification	18,011,997	27.746*** (1.960)	17.896*** (0.923)	-1.865 (2.032)
(3) Rating and date FEs	18,012,021	40.931*** (1.674)	24.951*** (0.802)	-3.484 (2.257)
(4) Issuer-date, rating, and dealer-date FEs (2007–2017)	12,771,031	30.696*** (2.036)	15.502*** (0.901)	10.292*** (2.302)
(5) Bond, rating, and date FEs	18,006,826	7.899*** (1.457)	2.612*** (0.663)	7.897*** (1.680)
(6) Weighted by R-squared	18,012,021	27.139*** (1.988)	17.354*** (0.969)	-4.157*** (2.000)
(7) Weighted by absolute value of t-stat	18,012,021	27.189*** (2.055)	17.763*** (0.963)	-3.796* (2.007)
(8) Weighted by mutual fund holding	18,012,021	28.065*** (2.469)	19.942*** (1.122)	-7.802*** (2.134)
(9) Sum of betas	18,012,021	9.098*** (1.771)	16.598*** (1.031)	-24.325*** (1.393)
(10) Bond yield	18,012,021	21.163*** (1.210)	11.033*** (0.537)	7.606*** (1.497)
(11) Yield spread, not tax-adjusted	18,012,021	12.172*** (1.281)	9.980*** (0.588)	-8.071*** (1.081)
(12) Controlling for lagged Amihud	13,081,428	25.508*** (2.562)	17.131*** (1.170)	-3.626 (2.348)
(13) Controlling for fund return	18,012,021	26.377*** (2.127)	18.184*** (0.991)	-4.622** (1.932)
(14) Controlling for flow pressure	17,987,982	25.068*** (2.079)	17.154*** (0.946)	-5.052** (1.992)
(15) Controlling for fund return & flow pressure	17,987,982	26.162*** (2.122)	18.171*** (0.990)	-5.106*** (1.915)
(16) Retail-sized trades	13,640,638	24.461*** (2.044)	16.365*** (0.910)	-5.107** (1.998)
(17) Institutional-sized trades	3,658,260	25.666*** (2.914)	18.305*** (1.462)	-3.139 (2.350)
(18) High mutual fund ownership	8,676,950	28.462*** (2.973)	20.591*** (1.317)	-8.884*** (2.564)
(19) Low mutual fund ownership	8,697,742	19.491*** (1.945)	12.992*** (0.913)	-1.836 (2.269)
(20) Positive aggregate net outflows	6,273,404	21.931*** (2.064)	15.190*** (0.851)	-9.426*** (3.043)
(21) Negative aggregate net outflows	11,738,617	27.327*** (2.323)	18.062*** (1.071)	-1.378 (2.215)
(22) Excluding COVID period	17,279,048	25.434*** (2.099)	17.234*** (0.958)	-4.392** (2.011)
(23) Subsample with non-missing bond beta	9,851,113	29.611*** (2.868)	19.427*** (1.336)	-2.180 (2.564)