

Prime Broker Credit Supply and the Stock Market

Evidence on Hedge Fund Transmission

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The views expressed are those of the authors and do not necessarily represent those of the Federal Reserve Board or its staff. All views are my own.

Motivation

1. Empirical intermediary asset pricing has been very successful.
 - ▶ Broker-dealer (B/D) factors explain returns across many asset classes (Adrian et al. [2014], He et al. [2017])
 - ▶ B/Ds direct ownership affect prices (Haddad and Muir [2021])

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2. But B/Ds do not only participate through direct investing.
3. In stock markets, B/Ds mainly participate by lending to hedge funds (HFs) via their prime brokers (PBs).
 - ▶ As of 2024, total PB lending to HFs: \$2.8T
 - ▶ ...but directly hold little: \$0.3T

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 - ▶ ...but directly hold little: \$0.3T
4. We test if, and under what conditions:

B/D $\Rightarrow$ HF $\Rightarrow$ Stock Market

Our key findings

When B/D distress is widespread, B/D credit supply transmits to stock prices

1. B/D financial health $\downarrow \implies$ B/D credit supply $\downarrow$
2. In widespread B/D distress, B/D credit supply $\downarrow \implies$ HF total borrowing and equity holding $\downarrow$
 - ▶ Why? HFs cannot fully substitute to healthier B/Ds
3. When HFs are forced to sell, stock prices $\downarrow$ before reverting
 - ▶ Sell-offs absorbed by non-levered investors
 - ▶ Large micro price impact multiplier
4. Aggregate B/D health declines identified from He et al. [2017]
factor $\rightarrow$ HF de-leveraging and underperformance of HF-owned stocks

Three complementary approaches to identify mechanism

Challenge: B/D credit quantities are endogenous to credit demand

1. **Cross-sectional event study** to identify credit supply shock
 - ▶ Variation: Origin of distress is orthogonal to prime brokerage
 - ▶ How? Distress among Euro B/Ds in Q1 2016
2. **Full panel regressions** to test whether “idiosyncratic” B/D shocks transmit to HF total borrowing
 - ▶ Variation: Broker-specific distress absent aggregate distress.
 - ▶ How? Panel+repeated cross-sections+collapse of Archegos
3. **Time-series correlations** to test whether aggregate patterns are consistent with the mechanism
 - ▶ Variation: Aggregate and/or common financial distress
 - ▶ How? He et al. [2017] factor

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Roadmap

Institutional Details and Data

Euro 5 Experiment

- Credit Supply Shock and HF Sell-Offs
- Stock-Level Sell-Offs and Price Impact

Intermediary Asset Pricing: When is there plausible transmission?

- Widespread distress in Q1 2016
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Data and Institutional Context

Data Sources: [▶ More](#)

- ▶ Form PF: Borrowing quantities information for HFs
 - ▶ Includes near universe of large hedge funds (including foreign)
- ▶ FactSet Ownership: Stock-level holdings by managers

Key Institutional Facts:

- ▶ HFs are the main levered equity investors in U.S. markets, hold 8.3% of average stock
- ▶ Prime brokers (divisions of B/Ds) provide this leverage
 - ▶ Leverage via margin lending (on balance sheet) and arranged financing (off balance sheet)
- ▶ Concentrated market: Top 10 B/Ds HF lending share is 80%
- ▶ HFs diversify: Large funds use 4.3 PBs on average

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PF analysis limited to aggregated sets of counter-parties!

[▶ Additional stock-level exposures](#)

[▶ Prime brokerage concentration](#)

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Widespread European B/D Distress in Q1 2016

Euro 5 (2016 Q1)

[▶ More Details](#)[▶ CDS Grouping](#)

- ▶ Idiosyncratic writes down by Deutsche Bank and Credit Suisse+ DB default concerns $\implies$ widespread contagion among Euro B/D
 - ▶ Idiosyncratic = shock originates outside prime brokerage
- ▶ **Grouping methodology:** Top quintile of B/Ds by Δ CDS spread on announcement dates
 - ▶ CS, DB, ACA, NWG, BCS [▶ Ex-Ante Similar](#)
 - ▶ All 5 realized large one-off charges [▶ Losses](#)
 - ▶ Market share of affected B/D: $\approx 33\%$
- ▶ Lending by E5 falls by $\approx 20\%$ [▶ Aggregate lending](#)

[▶ CDS spreads of Non-Shocked B/D](#)[▶ E5 Policy Reports](#)[▶ Understanding identification concerns](#)[▶ Full Details & Navigation](#)

Credit supply contracts from Euro 5 B/D

We regress:

$$\Delta \ln(PBL^{f,b}) = \alpha + \beta \cdot BorrowFromAnyTreated_{t-1}^{f,b} + \epsilon^f$$

	Credit Supply Contraction			Fund Substitution		
	$\Delta \log(PBL^{f,b})$		$\frac{\Delta PBL^{f,b}}{NAV^f}$	$\Delta \log(PBL^f)$		$\frac{\Delta PBL^f}{NAV^f}$
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated_{t-1}^{f,b}$	-0.158*** (0.035)	-0.155*** (0.036)	-0.024** (0.009)			
$BorrowFromAnyTreated_{t-1}^f$				-0.186*** (0.041)	-0.146*** (0.035)	-0.067*** (0.025)
R^2	0.64	0.59	0.49	0.058	0.048	0.227
N	1,086	962	962	493	415	415
Fund FE	X	X	X			
StratFE				X	X	X
MinEquity		X	X		X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- Funds borrow 2.4 p.p. less in $\frac{PBL}{NAV}$ from each treated B/D

► Broker-level: Full

► Methodology

... and Euro 5 funds cannot fully substitute

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- ▶ Exposed funds borrow 6.7 p.p. less $\frac{PBL}{NAV}$ in aggregate
- ▶ These results are similar to Kruttli et al. [2022]!

... and de-leveraging Euro 5 managers sell off equities

For each hedge fund (HF) manager m :

$$\Delta \ln(\text{EqHoldings}_{2016q1}^m) = \alpha + \beta \cdot \text{Treated}^m + \epsilon_{2016q1}^m$$

	$\Delta \text{Log}(PBL_{m,2016q1})$	$\Delta \text{Log}(Equity_{m,2016q1}^{mkt})$	$\Delta \text{Log}(Equity_{m,2016q1}^{stale})$	
	(1)	(2)	(3)	(4)
$Treated_{2015q4}^m$	-0.096*	-0.067**	-0.088***	-0.057*
	(0.052)	(0.034)	(0.034)	(0.032)
$\Delta \ln(PBL^m)$				0.100
				(0.089)
$Treated_{2015q4}^m \times \Delta \ln(PBL^m)$				0.243**
				(0.110)
Intercept	0.008	-0.083***	-0.025	-0.026
	(0.038)	(0.025)	(0.025)	(0.025)
R^2	0.017	0.020	0.034	0.195
N	196	196	196	196

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► $\text{StalePricePort}_t^m = \sum_s \text{Price}_{2015q4}^s \cdot \text{SharesHeld}_t^{m,s}$

► Similar evidence for fund-level exposure in PF

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Documenting Stock-Level Effects

1. Ex-ante exposure:

$$\% \text{ Held Euro5 HFs}_{2015q4}^s = \sum_{m \in M_{15q4}(s)} \text{MktShare}_{2015q4}^{s,m} \cdot \text{Treated}_{2015q4}^m$$

$$\text{where } \text{MktShare}_{2015q4}^{s,m} = \frac{\text{SharesHeld}_{2015q4}^{s,m}}{\text{SharesOutstanding}_{2015q4}^s}$$

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2. Exposure $\Rightarrow$ Stock Sell-offs:

$$\Delta \% \text{ Held Euro5 HFs}_{2016q1}^s = \alpha + \beta \cdot \% \text{ Held Euro5 HFs}_{2015q4}^s + \epsilon^s$$



► Evidence

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► Evidence

3. Exposure $\Rightarrow$ Stock Returns:

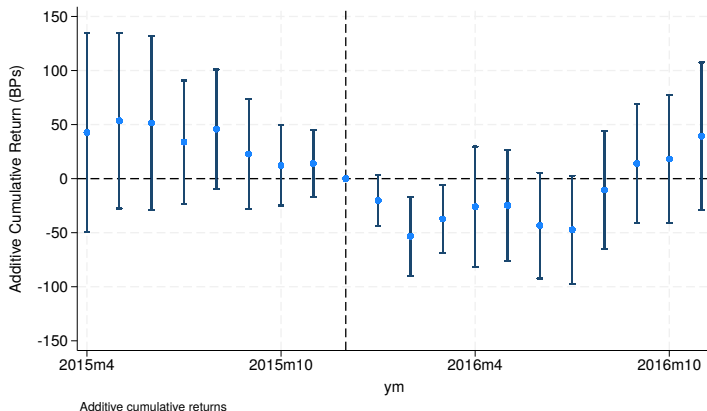
$$\text{ret}_{2016q1}^s = \alpha + \beta \cdot \% \text{ Held Euro5 HFs}_{2015q4}^s + \epsilon^s$$

where ret_{2016q1}^s denotes a realized return.



► Evidence

We observe price impact that subsequently reverts



$$\begin{aligned} cumret_{2015m12+\tau}^s &= \alpha + \beta\% \text{ Held Euro5 HFs}_{2015q4}^s \\ &+ \beta_2\% \text{ Held nonEuro5 HFs}_{2015q4}^s + \epsilon_{2015m12+\tau}^s \end{aligned}$$

Price impact is large

	Ex-ante Exposure			Realized Sell-offs			
	Ret_s	Ret_s	$\varepsilon_{FF4,s}$	Ret_s	Ret_s	Ret_s	$\varepsilon_{FF4,s}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
% Held Euro5 HFs _{2015q4}	-0.687*** (0.152)	-0.359*** (0.129)	-0.552*** (0.174)				
% Held non-Euro5 HFs _{2015q4}		-0.604*** (0.136)	-0.678*** (0.189)				
Δ % Held Euro5 HFs				1.022*** (0.347)	1.014*** (0.357)	2.629*** (0.603)	4.075*** (0.717)
Δ % Held non-Euro5 HFs					-0.653 (1.044)	-0.204 (1.610)	-0.718 (1.791)
R^2	0.02	0.21	0.20	0.01	0.01	0.02	0.05
N	1,537	1,537	1,537	1,537	1,537	828	828
IndustryFE		X	X				
E5SellOff						X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Large price impact multiplier (Gabaix and Koijen [2021])!

- ▶ Column (6): $\uparrow$ 1pp E5 sell-off $\implies$ 2.63pp $\downarrow$ returns
- ▶ Implied multipliers from (1)-(3): 2.9-4.72 Calculations

► Exposure $\Rightarrow$ Returns

► Sell-off $\Rightarrow$ Returns

- ▶ Inst. and direct controls

► Liquidity

Non-levered and more inelastic investors absorb sell-off

We compute for each other investor class i

$$\% \text{ Held }^i_t = \sum_{m \in M_t(s)} \text{MktShare}_t^{s,m} \cdot \text{ManagerClass}^i$$

We then estimate:

$$\Delta\% \text{ Held }^{s,i}_{2016q1} = \alpha + \beta \Delta\% \text{ Held Euro5 HFs}^s_{2016q1} + \epsilon^{s,i}_{2016q1}$$

	$\Delta\% \text{ Held nonEuro5 HFs}$	$\Delta\% \text{ Held Other HFs}$	$\Delta\% \text{ Held Brokers}$	$\Delta\% \text{ Held Households}$	$\Delta\% \text{ Held Inv Adv}$
	(1)	(2)	(3)	(4)	(5)
$\Delta\% \text{ Held Euro5 HFs}$	-0.021 (0.036)	-0.024 (0.058)	0.006 (0.022)	-0.486*** (0.101)	-0.397*** (0.110)
Intercept	-0.000 (0.000)	-0.001 (0.001)	-0.001*** (0.000)	-0.002* (0.001)	0.003** (0.001)
R^2	0.00	0.00	0.00	0.04	0.02
N	828	828	828	828	828

Standard errors in parentheses

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► In line with theories where asset holders matter for risk premia!

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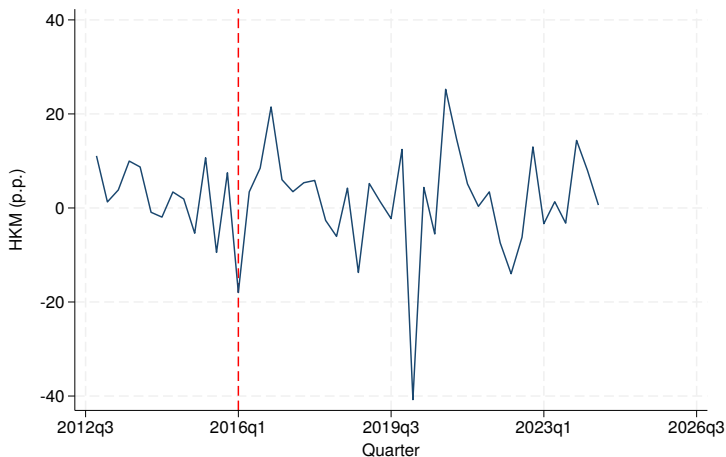
Widespread distress in Q1 2016

No evidence of transmission outside widespread distress

Evidence towards aggregate transmission

▶ Studying idiosyncratic shocks

Aggregate B/D health deteriorated in Q1 2016



- ▶ Q1 2016 shock occurs when standard intermediary asset pricing factor suggests deterioration

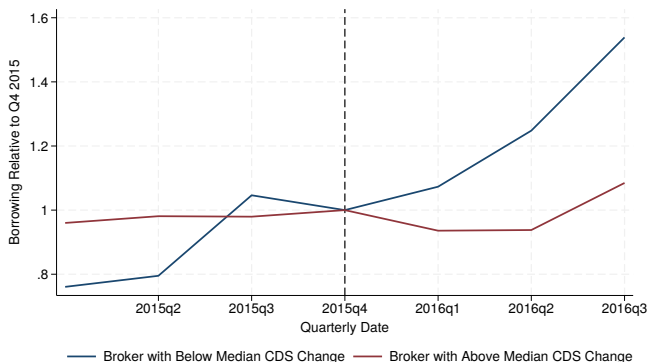
Does the widespread nature of the shock affect transmission?

- ▶ We test whether HFs substitute to relatively healthier B/Ds
- ▶ Non-treated B/Ds fin. health shows dispersion $\implies$ study the cross-section [▶ Details](#)

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▶ Details



- ▶ Healthier B/Ds are too small (\$19B total PBL) vs. funding lost (\$35B)
- ▶ Consistent with agg. B/D health mattering for transmission

▶ Consistent evidence in the cross-section

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► Results

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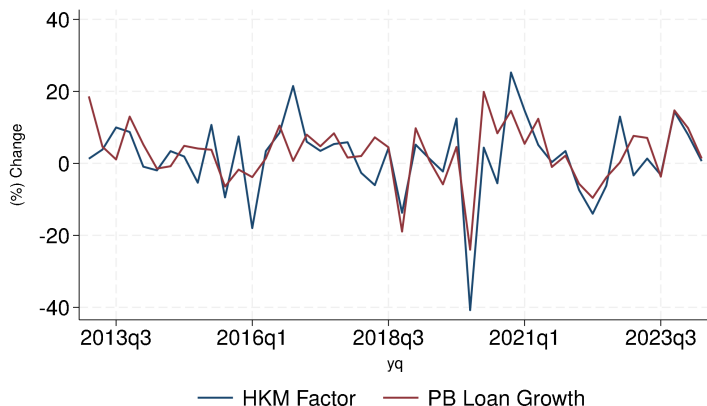
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Evidence towards aggregate transmission

PB Lending ↓ when Agg. B/D health ↓

Measure for aggregate B/D health: He et al. [2017] factor



► Correlation: 67%

When B/D ↓, PBL and Equity Holdings ↓

For $Y_t \in \{PBL_t, EquityPortSize_t^{HF}\}$, we estimate:

$$\frac{\Delta Y_t}{Y_{t-1}} = \alpha + \beta_1 HKM_t + \beta_2 \mathbb{1}(HKM < 0) + \beta_3 HKM_t \times \mathbb{1}(HKM < 0) + \epsilon_t$$

When $B/D \downarrow$, PBL and Equity Holdings $\downarrow$

For $Y_t \in \{PBL_t, EquityPortSize_t^{HF}\}$, we estimate:

$$\frac{\Delta Y_t}{Y_{t-1}} = \alpha + \beta_1 HKM_t + \beta_2 \mathbb{1}(HKM < 0) + \beta_3 HKM_t \times \mathbb{1}(HKM < 0) + \epsilon_t$$

	ΔPBL	ΔML	$\Delta Port^{mkt}$	$\Delta Port^{state}$	$\Delta Port^{state,int}$	
	(1)	(2)	(3)	(4)	(5)	(6)
HKM Factor	0.052 (0.232)	0.109 (0.068)	0.244** (0.112)	-0.064 (0.074)	-0.066 (0.085)	-0.119 (0.071)
1(HKM < 0)	-0.026 (0.029)	0.005 (0.007)	-0.013 (0.022)	0.017 (0.016)	0.020 (0.016)	0.012 (0.009)
1(HKM < 0) × HKM Factor	0.642** (0.249)	0.472*** (0.120)	0.377*** (0.137)	0.262** (0.125)	0.256* (0.133)	0.240*** (0.079)
Constant	0.055** (0.022)	0.016*** (0.005)	0.060*** (0.013)	0.045*** (0.009)	0.025*** (0.009)	0.015** (0.006)
Observations	40	240	80	80	80	40
R-squared	0.524	0.326	0.416	0.067	0.069	0.178
Sample	2013-	2003-	2003-	Full	2003-	2013-

Standard errors in parentheses

* $p < 0.10$. ** $p < 0.05$. *** $p < 0.01$

- ▶ Severe B/D health events $\implies$ de-leveraging and selling
 - ▶ Survey evidence: when B/D health $\downarrow$, more brokers report tightening financing rates ▶ SCOOS

When B/D health ↓, HF-exposed stocks perform poorly

$$\begin{aligned} ret_t^{HF} = & \alpha + \beta_1 HKM_t + \beta_2 \mathbb{1}(HKM < 0) + \beta_3 HKM_t \times \mathbb{1}(HKM < 0) \\ & + \gamma F_t + \epsilon_t \end{aligned}$$

where ret_t^{HF} is the high-minus-low return of quintile portfolios sorted on HF ownership

Conclusion

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We present causal evidence of transmission mechanism

- ▶ B/D distress $\implies$ HFs are forced to de-lever
- ▶ Forced deleveraging $\implies$ HFs sell to more inelastic investors.
- ▶ Conditions $\implies$ large price impact

Aggregate analysis suggests that widespread distress:

- ▶ is a condition for transmission from B/D to stock market
- ▶ can be indexed by standard intermediary asset pricing factors

Contribution:

- ▶ Intermediaries can affect prices via *indirect participation*
- ▶ Economic channel linking B/Ds to equity prices

Thank you!

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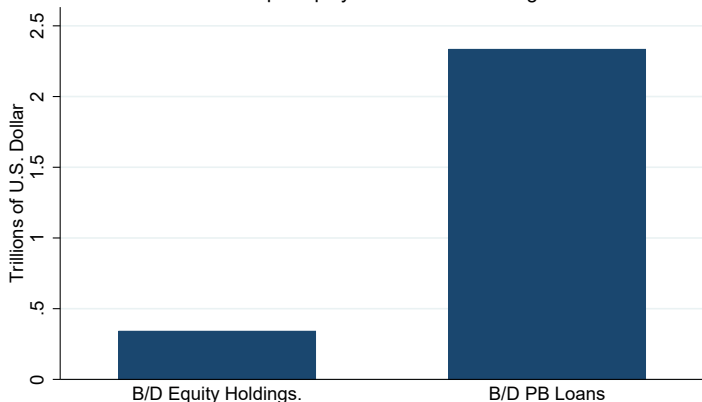
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B/D Lending to HFs is Large

Broker Participation: Direct vs. Indirect Channels

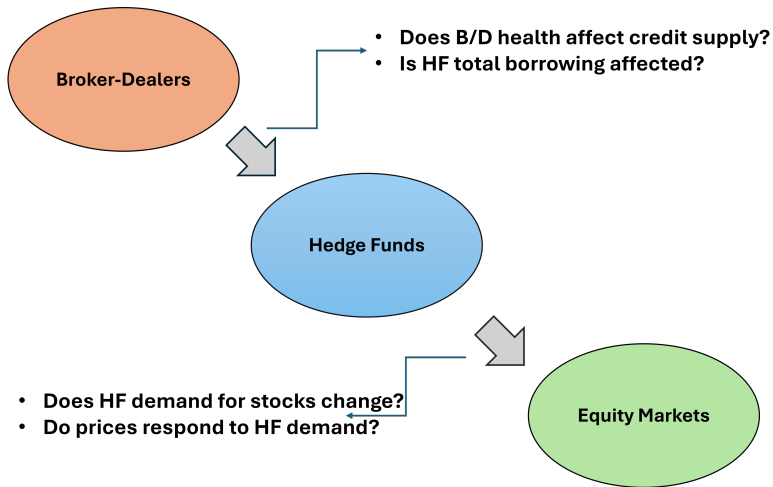
2024q2: Equity and Prime Brokerage



Data: OFR Hedge Fund Monitor (U.S. Regulated HF)
Broker-Dealer Holdings data from Fed Fin. Acc. (U.S. Regulated)

- Much larger than Commercial & Industrial Loans by G-SIBs (\$1T)

The Credit Supply Transmission Mechanism



► Return

Related Literature and Contributions

1. Intermediary Asset Pricing:

1.1 **Theory:** He and Krishnamurthy [2013], Brunnermeier and Sannikov [2014], Brunnermeier and Pedersen [2008]

1.2 **Empirical:** Adrian et al. [2014], He et al. [2017], Ma [2023], Siriwardane [2019], Haddad and Muir [2021], Seegmiller [2024]

Contribution: We provide causal evidence for the credit supply transmission mechanism in equity markets.

2. Hedge Funds, Leverage, and Brokers:

2.1 Aragon and Strahan [2012], Barth et al. [2022, 2021], Kruttli et al. [2022], Dahlqvist et al. [2021]

Contribution 1: We document the full transmission channel, which

Contribution 2: ...depends on HF's capacity to substitute across B/Ds

Contribution 3: ...which, in turn, depends on the health of other B/Ds.

3. Inelastic Markets and Asset Prices

3.1 Koijen and Yogo [2019], Koijen et al. [2023], Gabaix and Koijen [2021]

Contribution: We estimate the first price multiplier for a shock to arbitrage capital in a period of intermediary distress.

HF's borrow from multiple but not all B/Ds

	(1) At least \$1B in PBL	(2) Any PBL
Mean Number of PB	4.30	3.09
SD Number of PB	3.24	2.87
10th Pctile Number of PB	2.00	1.00
25th Pctile Number of PB	2.00	1.00
50th Pctile Number of PB	3.00	2.00
75h Pctile Number of PB	5.00	4.00
90th Pctile Number of PB	7.00	6.00
Mean of Max Borr Shr	0.52	0.65
Mean of Dev Borr Shr	0.16	0.12
Number of Fund by Q obs in Sample	7529	20911

[▶ Return](#)[▶ Return to institutional details](#)

HF-PB Institutional Details

- ▶ HFs are active investors with broad mandates:
 - ▶ In U.S. equity markets, HFs are the main levered investors
 - ▶ Equity leverage is provided mainly from PBs
- ▶ Broker-Dealer Industrial Organization
 - ▶ Prime brokers are the divisions of B/Ds that lend to HFs
 - ▶ 90% of HF lending by B/Ds in G-SIBs
 - ▶ The top 10 B/Ds account for 80% of HF lending
- ▶ Hedge Fund Market Structure
 - ▶ Large HFs (> \$1B in PB lending) have 4.3 PBs on average
 - ▶ \$3 trillion in long cash equity exposures
 - ▶ PF HFs hold 8.27% of mean stock and account for about 18% of the mean stock's turnover

▶ Additional stock-level exposures

▶ Prime brokerage concentration

▶ Return

Stocks are heterogeneously exposed to HFs

Statistic	Mean	SD	P50	P10	P25	P75	P90
HF Market Share	8.27	10.53	4.50	0.69	1.83	10.15	20.49
HF Inst. Share	12.23	14.83	6.77	1.38	2.96	14.84	30.56
HF Turnover Share (1)	17.66	14.00	14.09	4.09	7.89	23.37	35.59
HF Turnover Share (2)	19.08	15.70	15.49	2.12	6.47	28.15	41.13
Number of Managers	16.46	11.18	14.00	4.00	8.00	22.00	31.00

[▶ Return to identification](#)[▶ Return to institutional details](#)

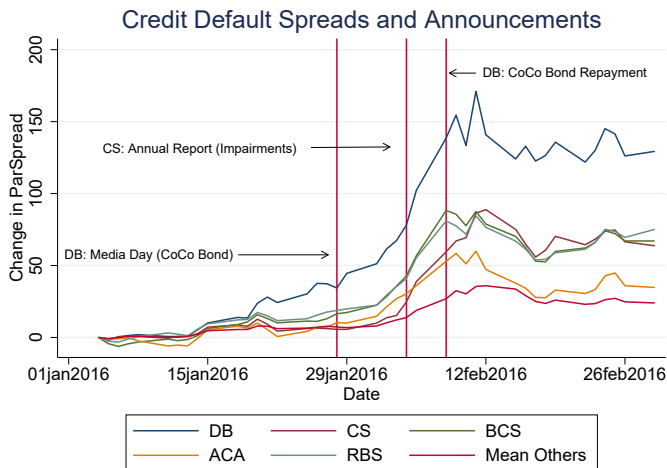
Regulatory Data: Form PF

- ▶ Dodd-Frank mandated enhanced regulatory reporting for private funds — primarily implemented through **Form PF**
- ▶ Advisers with $\geq$ \$150 million in regulatory private fund assets provide detailed data each year on the hedge funds they advise
- ▶ Advisers with $\geq$ \$1.5 billion of hedge fund assets (“large hedge fund advisers”) report at a quarterly frequency, and provide additional details
 - ▶ These advisers provide even more details for their “qualifying hedge funds” ($\geq$ \$500 mm) → account for 86% of all HF assets
- ▶ Form PF data includes gross and net assets, gross- and net-of-fee returns, asset class exposures, types of borrowing, counterparty exposures and creditors, asset and investor liquidity, and much more
 - ▶ Key variable: fund-by-broker borrowing quantities (Q47)

ES2: European Broker-Distress in Q1 2016

- ▶ Near Default of **Deutsche Bank** (DB) shook markets
 - ▶ **2015 Q4:** EUR 6 billion write-downs in non-US retail banking. (15% of net worth)
 - ▶ **Jan 28, 2016:** Uncertainty emerged if DB could repay subordinated debt (CoCos) at DB Media Day
- ▶ Other European B/Ds suffered losses, namely **Credit Suisse**
 - ▶ **CS-Feb 4, 2016:** Good-will impairment (9% of net worth)
- ▶ Investors became worried about Euro B/Ds in general:
“The worries about these bonds represent real fears that the European banking system may be weaker and more vulnerable...than a lot of people originally thought”–A major HF manager (02/08/16)

CDS Spreads: Euro 5 Identification



- ▶ Top quintile of B/Ds of Δ CDS spread changes on announcement dates:
- ▶ Ex-ante lending share of E5: about 33% (like Archegos)

▶ E5: Ex-ante characteristics and ex-post outcomes

▶ E5 Announcements

▶ All brokers had major restructuring losses in Q1 and Q2 2016

These spill-over brokers were ex-ante less profitable and showed higher reliance on lower tier capital

Ex-ante less-profitable as:

$$\frac{MarketCap_{2015q3}}{BookEquity_{2015q3}} = \alpha + \underbrace{\beta}_{-.5} Spillover + \epsilon \quad (1)$$

Ex-ante more reliant on lower tier capital by:

$$\frac{AT1_{2015q3} + Tier2Capital_{2015q3}}{TotalCapital_{2015q3}} = \alpha + \underbrace{\beta}_{12\%} Spillover + \epsilon \quad (2)$$

$$AT1_{2015q3} + Tier2Capital_{2015q3} = \alpha + \underbrace{\beta}_{3\%} Spillover + \epsilon \quad (3)$$

Moreover, two of three spillover brokers (BCS, RBS/NWG) announced billion dollar write-downs later in the quarter.

[▶ Return](#)

One-off charges by E5 broker-dealers

Name	Date Announced	Quarter	Losses	Type	Δ CDS
RBS/NWG	02/26/2016	2015 Q4	2.21bn pounds	Legal/restructuring	36.9
BCS	03/1/2016	2015 Q4	1.878bn pounds	Legal/restructuring	45.9
ACAEN	02/17/2016	2016 Q1	470 mn euros	Restructuring	26.1

- ▶ This is evidence that each of these banks experienced balance sheet disruption similar to DB/CS
- ▶ Caveat: Due to confidentiality, we cannot test bank-specific credit reductions due to these disruptions.

Additional narrative evidence of E5 shock

1. Fed: “The angst in global financial markets—reinforced by some unsettling news about the health of European banks—extended through mid-February” (March 2016 Tealbook A)
2. BIS: “The securities of European banks were hit particularly hard in the first weeks of 2016... Concerns about the sector’s prospects, particularly with respect to earnings, seem to have been on investors’ minds.” (March 2016 BIS QR)
3. IMF: “Difficulties in business model transitions and legal costs have led to extraordinarily weak earnings results at several large European banks...One manifestation of this challenge is the sharp repricing in January and February in the market for subordinated and convertible debt-equity hybrid securities—on which some European banks have relied heavily.” (April 2016 GFSR)

Cross-Sectional Credit Supply Empirical Design

1. Do broker shocks associate with **lending quantities**?

$$\Delta PBL^b = \alpha + \beta \cdot Treated^b + \epsilon^b$$

2. If so, is there evidence of a **credit supply channel**?

$$\Delta PBL^{f,b} = \alpha_f + \beta \cdot Treated^{f,b} + \epsilon^{f,b}$$

3. Can funds substitute across brokers?

$$\Delta PBL^f = \alpha + \beta \cdot AnyDistressedBroker^f + \epsilon^f$$

4. Does imperfect substitution trigger stock sell-offs?

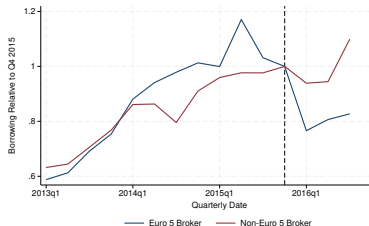
$$\Delta EquityHoldings^f = \alpha + \beta \cdot AnyDistressedBroker^f + \epsilon^f$$

Aggregate Substitution Tests

Plot: Total borrowing by group for funds ex-ante exposed to E5

Exposed Funds' Borrowing

(a) Euro 5



(b) Archegos



- ▶ Identical results by testing substitution for average fund in x-section
- ▶ KM estimator makes up about 60% of total lending

▶ Return

Credit Supply Contraction in Q1 2016

We estimate:

$$\Delta PBL^{f,b} = \alpha_f + \beta \cdot Treated^{f,b} + \epsilon^{f,b}$$

	$\Delta \log(PBL_t^{f,b})$							$\frac{\Delta PBL_t^{f,b}}{NAV_t^{f,b}}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treated_{2015q4}^{f,b}$	-0.141*** (0.037)	-0.164*** (0.037)	-0.156*** (0.038)	-0.172*** (0.037)	-0.158*** (0.035)	-0.155*** (0.036)	-0.163*** (0.035)	-0.022** (0.008)	-0.024** (0.009)
$OtherForeignBroker_{2015q4}^{f,b}$							-0.027 (0.054)		
R^2	0.01	0.07	0.04	0.10	0.64	0.59	0.64	0.01	0.49
N	1,103	1,103	1,103	1,103	1,086	962	1,086	974	962
Controls		X		X					
StratFE			X	X					
KMFE					X	X	X		X
Sample						Large Eq		Large Eq	Large Eq

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- ▶ Column (2): 16.4% decline in PBL at distressed brokers
- ▶ Column (9): 2.4pp decline in PBL/NAV ratio at distressed brokers

Credit Supply Contraction in Q2 2021

We estimate:

$$\Delta PBL^{f,b} = \alpha_f + \beta \cdot Treated^{f,b} + \epsilon^{f,b}$$

	$\Delta \text{Log}(PBL_t^{f,b})$							$\frac{\Delta PBL_t^{f,b}}{NAV_{t-1}^{f,b}}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treated_{2021q1}^{f,b}$	-0.074**	-0.073**	-0.083***	-0.083***	-0.079***	-0.085***	-0.082***	-0.024**	-0.024***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.028)	(0.028)	(0.029)	(0.009)	(0.008)
$OtherForeignBroker_{2021q1}^{f,b}$							-0.015 (0.031)		
R^2	0.01	0.02	0.07	0.08	0.52	0.51	0.52	0.01	0.42
N	1,183	1,183	1,183	1,183	1,169	1,043	1,169	1,054	1,043
Controls		X		X					
StratFE			X	X					
KMFE					X	X	X		X
Sample						Large Eq		Large Eq	Large Eq

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- ▶ Fund-level: Full

► [Return](#)

Fund Substitution in Q1 2016

We estimate:

$$\Delta PBL^f = \alpha + \beta \cdot \text{AnyDistressedBroker}^f + \epsilon^f$$

	$\Delta \log(PBL_t^f)$					$\frac{\Delta PBL_t^f}{NAV_t^f}$
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated_{2015q4}^f$	-0.186*** (0.041)	-0.146*** (0.035)	-0.139*** (0.032)	-0.207*** (0.045)	-0.140*** (0.033)	-0.067*** (0.025)
EEA Holdings					0.028 (0.159)	
R^2	0.058	0.048	0.155	0.205	0.155	0.227
N	493	415	415	252	415	415
StratFE	X	X	X	X	X	X
Controls			X	X	X	X
MinEquity		X	X	X	X	X
Sample	All	All	All	Foreign	All	All

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- ▶ Column (1): 18.6% decline in aggregate PBL for exposed funds
- ▶ Column (6): 6.7pp decline in PBL/NAV ratio for exposed funds

Fund Substitution in Q2 2021

$$\Delta PBL^f = \alpha + \beta \cdot \text{AnyDistressedBroker}^f + \epsilon^f$$

	$\Delta \text{Log}(PBL_t^f)$				$\frac{\Delta PBL_t^f}{NAV_{t-1}^f}$
	(1)	(2)	(3)	(4)	(5)
$Treated_{2021q1}^f$	-0.005 (0.034)	-0.021 (0.032)	0.005 (0.031)	0.071 (0.071)	0.096*** (0.030)
Intercept	0.061** (0.028)	0.073*** (0.027)	0.026 (0.029)	-0.040 (0.068)	-0.024 (0.024)
R^2	0.050	0.070	0.136	0.151	0.119
N	463	398	398	311	398
StratFE	X	X	X	X	X
Controls			X	X	X
MinEquity		X	X	X	X
Sample	All	All	All	Foreign	All

Standard errors in parentheses

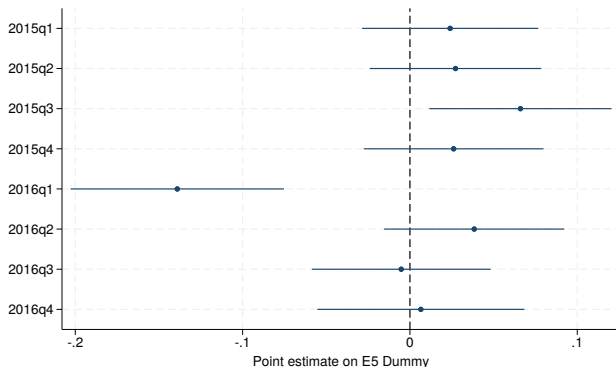
^{*} $p < 0.10$, ^{**} $p < 0.05$, ^{***} $p < 0.01$

► Return

Imperfect substitution only observed in Q1 2016

We regression for $q \in \{2015q1, 2016q4\}$

$$\Delta PBL_q^f = \alpha + \beta Treated^f + \gamma X^f + \epsilon^f \quad (4)$$



► Return

Fund by Broker Substitution in Q1 2016

We estimate:

$$\Delta \log(PBL_{2016q1}^{f,b}) = \alpha + \beta CumulativeEuroCDS^b + \epsilon_{2016q1} \quad (5)$$

(6)

where $CumulativeEuroCDS^b$ is the change in CDS spreads over E5 event s

	$\Delta \text{Log}(PB_{f,t,b})$			
	(1)	(2)	(3)	(4)
Cumulative Event CDS Spreads Chg	-1.069** (0.458)			
Below Median CDS Chg		0.307*** (0.116)	0.392*** (0.117)	0.400*** (0.101)
Above Median CDS Chg			0.084** (0.038)	0.138*** (0.033)
Intercept	0.155* (0.094)	-0.073*** (0.023)	-0.157*** (0.030)	-0.186*** (0.027)
R^2	0.01	0.02	0.02	0.59
N	498	498	756	751
Sample	non-Euro 5	non-Euro 5	All	All
KMFE				X
Outcome	Log	Log	Log	Log

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

PF equity exposures decrease

For a given asset class j , we estimate the following model:

$$\Delta Asset_{2016q1,j}^f = \alpha + \beta Treated_{2015q4}^f + \gamma X^f + \epsilon_{2016q1,j}^f \quad (7)$$

	$\Delta \text{Log}(\text{LongEq}_{f,t})$			$\Delta \text{Log}(\text{ShortEq}_{f,t})$	$\Delta \text{Log}(\text{Bonds}_{f,t})$	$\Delta \text{Log}(\text{FX}_{f,t})$	$\Delta \text{Log}(\text{RF}_{f,t})$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Treated</i> ^t _{2015q4}	-0.068*** (0.023)	-0.062*** (0.022)	-0.055*** (0.018)	-0.043 (0.030)	-0.119 (0.085)	0.195* (0.108)	0.029 (0.055)
Intercept	-0.050*** (0.015)	-0.054*** (0.016)	-0.019 (0.013)	0.037 (0.023)	0.217*** (0.064)	-0.077 (0.085)	0.071 (0.046)
<i>R</i> ²	0.021	0.053	0.338	0.145	0.037	0.030	0.099
<i>N</i>	415	415	415	408	216	313	373
StratFE		X	X	X	X	X	X
Controls			X	X	X	X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

► Return

Back-of-the-Envelope Calculations

Earlier, we estimated the following regressions:

$$\underbrace{\Delta \% \text{ Held Euro5 HFs}}_{\frac{\Delta Q}{Q}}_{2016q1}^s = \alpha + \beta_1 \cdot \% \text{ Held Euro5 HFs}_{2015q4}^s + \epsilon^s \quad (8)$$

$$\underbrace{\text{ret}}_{\approx \frac{\Delta P}{P}}_{2016q1}^s = \alpha + \beta_2 \cdot \% \text{ Held Euro5 HFs}_{2015q4}^s + \epsilon^s \quad (9)$$

Using these estimates, we compute the multiplier as:

$$M = \frac{\frac{\Delta P}{P}}{\frac{\Delta Q}{Q}} = \frac{\beta_2}{\beta_1}$$

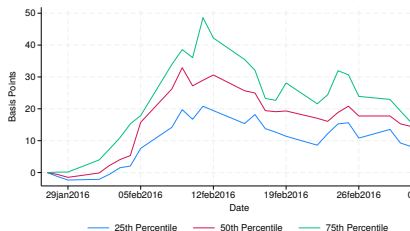
Our results suggest:

- ▶ $M = 2.65 = \frac{-0.359}{-0.124}$ for all sell-offs.
- ▶ $M = 4.72 = \frac{-0.359}{-0.076}$ for abnormal sell-offs.

Shocks differs on how widespread across non-treated B/Ds

Cumulative CDS Spread Changes of Non-Shocked Brokers

(a) Euro 5



Cumulative Changes are measured from Jan 27 to February 29, 2016.
Brokers identified from Form PF, CDS spread from Markit

(b) Archegos



Cumulative Changes are measured from March 24th to May 31, 2021.
Brokers identified from Form PF, CDS spread from Markit

- ▶ Average broker-dealers' financial health deteriorated in E5, but not A5.
- ▶ ...also heterogeneity in which broker-dealers experienced pressures in E5.

Limited cross-sectional variation during pandemic

For different financial health measures in Q1 2020, we estimate:

$$\Delta \ln PBL_{2020q1}^{b,f} = \alpha_f + \beta \text{Health}_{2020q1}^b + \epsilon^{b,f} \quad (10)$$

	$\Delta \ln(PB_{f,b,t})$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta CDS_{eq,t}^b$	-0.024 (0.112)				-0.021 (0.098)			
$\Delta MktNetWorth_t^b$		-0.141 (0.168)				-0.077 (0.140)		
$\Delta CDS_{max,t}^b$			-0.044 (0.053)				-0.038 (0.050)	
Top 5 Bank				-0.004 (0.043)				-0.011 (0.039)
Intercept	-0.311*** (0.077)	-0.395*** (0.084)	-0.271*** (0.071)	-0.325*** (0.031)	-0.313*** (0.065)	-0.364*** (0.070)	-0.280*** (0.063)	-0.322*** (0.024)
R^2	0.00	0.00	0.00	0.00	0.59	0.59	0.59	0.59
N	1,037	1,037	1,037	1,037 Ple	1,037	1,037	1,037	1,037
FE	None	None	None	None	KM	KM	KM	KM

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Return

Identification

- ▶ **E5 Identification Concern:** We group together five banks
 - ▶ What if some banks in Euro 5 aren't actually shocked?
 - ▶ Misclassification $\implies$ including untreated banks in treatment group
- ▶ **Implication:** Misclassification causes *attenuation bias toward zero*
 - ▶ Our point estimates are **conservative/lower bounds** on true effects
 - ▶ Finding significant effects *strengthens* the evidence
- ▶ **Bottom line:** Misclassification affects *magnitude* (makes estimates smaller) but not *validity* of causal inference based on ex-ante exposures.

Identification: Credit Supply Tests

Our Specifications:

$$\Delta \text{PBL}^{f,b} = \alpha^f + \beta^1 \cdot \text{Treat}^b + \epsilon^{f,b} \quad (\text{Khwaja-Mian})$$

$$\Delta \text{PBL}^f = \alpha + \beta^2 \cdot \text{Treat}^f + \epsilon^f \quad (\text{Imperfect Substitution})$$

Effect of Misclassification:

- ▶ If only $N^{1'} \subset N^1$ are truly shocked (and $N^1 \setminus N^{1'}$ mistakenly included) and all treated banks contract credit γ
- ▶ Estimated effect: $\hat{\beta}^1 = \gamma \times \sum_{b \in N^{1'}} \frac{n^b}{n^{\text{treat}}} \cdot \text{Treat}^b$
- ▶ True effect: $\beta^{1,\text{true}} = \gamma \times \sum_{b \in N^{1'}} \frac{n^b}{n^{\text{treat}'}} \cdot \text{Treat}^b$
- ▶ Since $n^{\text{treat}} = \sum_{b \in N^1} n^b > n^{\text{treat}'} = \sum_{b \in N^{1'}} n^b$:

$$\hat{\beta}^1 < \beta^{1,\text{true}} \quad (\text{Attenuation Bias})$$

Identification: Asset Pricing Tests

Our Specifications:

$$ret_t^s = \alpha + \beta^1 \cdot Q_{t-1}^{s,E5} + \epsilon^s \quad (\text{Ex-Ante Exposure})$$

$$ret_t^s = \alpha + \beta^2 \cdot \Delta Q_t^{s,E5} + \epsilon^s \quad (\text{Realized Sell-Offs})$$

where $Q^{s,E5} = \sum_m Treat^m \times \frac{\text{Shares Held}^{s,m}}{\text{Shares Outstanding}^s}$

Effect of Misclassification:

- ▶ **Ex-ante exposure:** Classical measurement error $\implies$ attenuation bias

$$\hat{\beta}^1 = \lambda \cdot \beta^{1,true} \quad \text{where } \lambda = \frac{\text{Var}(Q^{true})}{\text{Var}(Q^{measured})} < 1$$

- ▶ **Realized sell-offs:** *Robust* to bank misclassification
 - ▶ Actual changes in holdings reflect who truly sold
 - ▶ Key assumption: sell-offs driven by credit shocks, not fundamentals

Asymmetric pass-through in regression form

	<i>spread_t^{hf}</i>						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HKM Factor	0.096*** (0.028)	0.042 (0.044)	0.093 (0.075)	0.077** (0.032)	0.025 (0.040)	0.039 (0.066)	0.002 (0.042)
Market Excess Return		0.001 (0.001)	-0.001 (0.001)		0.001 (0.001)	-0.001 (0.001)	0.002* (0.001)
Bottom Decile of HKM				0.030*** (0.011)	0.033*** (0.011)	0.047*** (0.018)	0.029*** (0.010)
HKM × Bottom Decile				0.260*** (0.064)	0.264*** (0.066)	0.434*** (0.081)	0.414*** (0.107)
Bottom Decile × Market							-0.004** (0.002)
Observations	252	252	117	252	252	117	252
R-squared	0.064	0.078	0.023	0.089	0.105	0.090	0.125

► Return

Higher exposure $\Rightarrow$ Higher sell-off

To validate that this measure captures abnormal sell-offs:

$$\Delta\% \text{ Held Euro5 HFs}_t^s = \alpha_t + \beta_1\% \text{ Held Euro5 HFs}_{t-1}^s + \beta_2\% \text{ Held Euro5 HFs}_{t-1}^s \times Q12016 + \epsilon_t^s$$

	$\Delta\%HeldEuro5HF_s$				
	(1)	(2)	(3)	(4)	(5)
Lag % Held Euro5 HF _s	-0.124*** (0.016)	-0.048*** (0.005)	-0.049*** (0.005)	-0.050*** (0.006)	-0.052*** (0.006)
Lag % Held Euro5 HF _s × I{Q12016}		-0.076*** (0.005)	-0.075*** (0.005)	-0.077*** (0.005)	-0.076*** (0.005)
Intercept	0.004*** (0.001)	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.004*** (0.000)
R^2	0.10	0.02	0.03	0.03	0.03
N	1,537	19,548	19,548	19,548	19,548
Q12016	X				
Qtr×YearFE			X		X
IndustryFE				X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- ▶ Column (1): 1pp $\uparrow$ in E5 exposure $\Rightarrow$ 12.4bps $\uparrow$ sell-off

Stocks more sold-off by E5 mgrs have lower returns

	$Ret_{s,t}$						$\varepsilon_{CAPM,s,t}$	$\varepsilon_{FF4,s,t}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta\%HeldEuro5HF_s$	1.022*** (0.347)	2.633*** (0.596)	1.014*** (0.357)	2.629*** (0.603)	4.083*** (0.953)	4.058*** (0.963)	2.617*** (0.586)	4.075*** (0.717)
$\Delta\%HeldnonEuro5HF_s$			-0.653 (1.044)	-0.204 (1.610)		-1.242 (1.779)	-0.555 (1.632)	-0.718 (1.791)
Intercept	0.011 (0.017)	0.036** (0.017)	0.011 (0.017)	0.036** (0.018)	0.075*** (0.024)	0.075*** (0.025)	0.029 (0.018)	0.044*** (0.015)
R^2	0.01	0.02	0.01	0.02	0.04	0.05	0.02	0.05
N	1,537	828	1,537	828	414	414	828	828
E5SellOff		X		X	Above p50	Above p50	X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

► Return

Results robust to other institutional investor controls

$$ret_{t \rightarrow t+1}^S = \alpha + \beta \Delta MktShareE5HFs_{t \rightarrow t+1}^S + \epsilon_{t \rightarrow t+1}^S \quad (11)$$

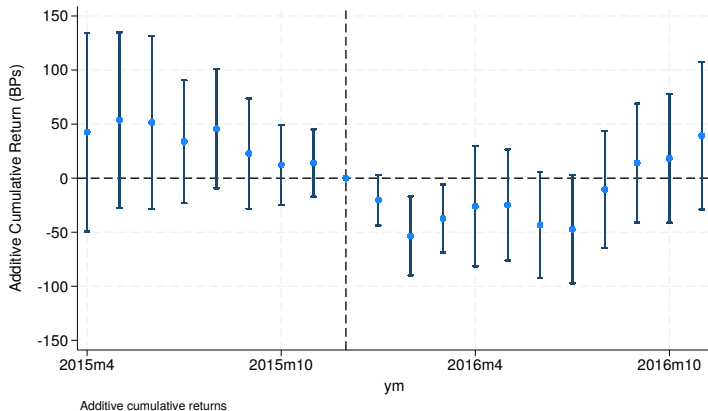
	<i>Ret_{s,t}</i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Held Euro5 HFs	-0.447*** (0.140)	-0.455*** (0.145)	-0.444*** (0.133)	-0.559*** (0.153)	-0.458*** (0.135)	-0.474*** (0.136)	-0.501*** (0.139)	-0.499*** (0.141)
% Held Other HF	-0.162 (0.109)							
% Held Brokers		-0.515 (0.756)						
% Held InvAdv			0.100*** (0.033)					
% Held Inst.				0.045 (0.030)				
% Held E5 B/D					-2.133* (1.172)			
% Held E5 Affiliate						-1.428 (1.158)		
E5 Bank in Syndicate							-0.003 (0.036)	
E5 Bank Lead								-0.080** (0.036)
Intercept	0.048*** (0.013)	0.036*** (0.010)	-0.025 (0.018)	-0.003 (0.022)	0.037*** (0.007)	0.036*** (0.008)	0.032*** (0.006)	0.032*** (0.006)
R ²	0.21	0.21	0.21	0.21	0.21	0.21	0.20	0.20
N	1,537	1,537	1,537	1,537	1,537	1,537	1,537	1,537
IndustryFE	X	X	X	X	X	X	X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Reversions with industry controls

► Return



We estimate a *large* price impact multiplier

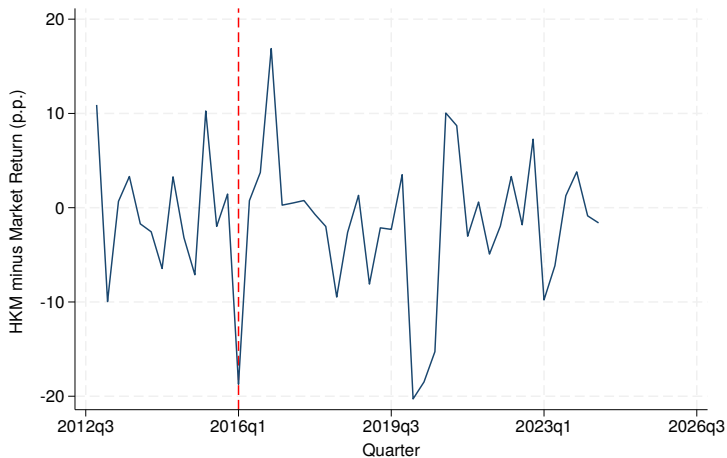
- ▶ Compute price multiplier:

$$M = \frac{\frac{\Delta P^s}{P^s}}{\frac{\Delta Q^{s,E5}}{Q^{s,E5}}}$$

- ▶ OLS Sell-Off Estimate: 2.63-4.075 for sell-offs
- ▶ From ex-ante measures: 2.9 (sell-off) or 4.72 (ab. sell-off)
- ▶ Is this big?
 - ▶ Gabaix and Koijen [2021] (Micro): Estimates from 0.7 to 2.5
- ▶ This is the first estimate of a direct shock to arbitrageur capital where:
 - ▶ Liquidity deteriorates
 - ▶ Uncertainty increases
 - ▶ and ...

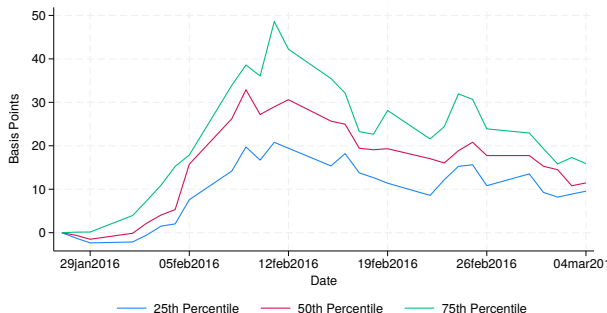
▶ Uncertainty Quote

Results on stronger when accounting for market return



Non-treated B/Ds health deteriorates on average, substantial variation

Cumulative CDS Spread Changes of Non-Shocked Brokers (a) Euro 5



Cumulative Changes are measured from Jan 27 to February 29, 2016.
Brokers identified from Form PF, CDS spread from Markit

- Average broker-dealers' financial health deteriorated in E5
- ...also heterogeneity in which broker-dealers experienced pressures in E5.

Generally testing role of non-shocked B/D health

1. Our event studies show:

- ▶ Idiosyncratic shocks (*Archegos*) $\implies$ diversified away
- ▶ Widespread shocks (*Euro 5*) $\implies$ transmit

2. **Are idiosyncratic shocks generally substitutable?**

- ▶ Proxy for shocks using large Δ CDS spreads
- ▶ These cross-sectional shocks are idiosyncratic (except E5)
- ▶ Strong evidence: broker health $\implies$ credit supply
- ▶ We never document imperfect substitution outside E5

Yes.

▶ Panel Results

▶ Covid and CS X-Section

▶ Return

Is the panel evidence consistent with the event studies?

- Construct from CDS spreads a panel measure of broker distress:

$$\begin{aligned}Distress_t^b &= CDS_{t,max}^b - CDS_{t-1,eq}^b \\ AbnormalDistress_t^b &= Distress_t^b - \overline{Distress}_t\end{aligned}$$

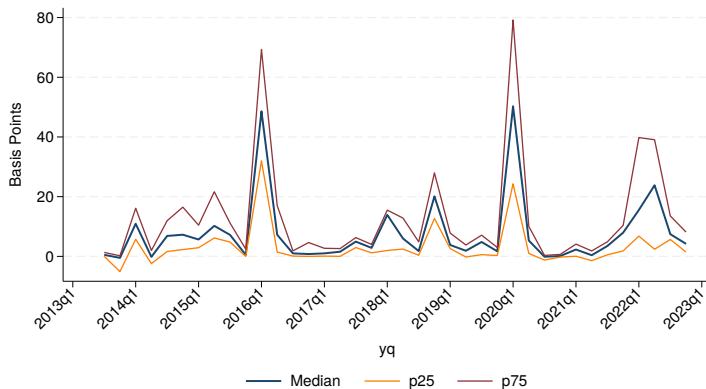
- Construct discrete treatment as:

$$BigShock_t^b = \begin{cases} 1 & \text{if } AbnormalDistress_t^b \geq P_\tau(AbnormalDistress), \\ 0 & \text{otherwise} \end{cases}$$

where τ is a percentile cut-off

- Test impact on broker-level lending and hedge fund equity holdings.

Limited evidence of **widespread** distress outside Euro 5



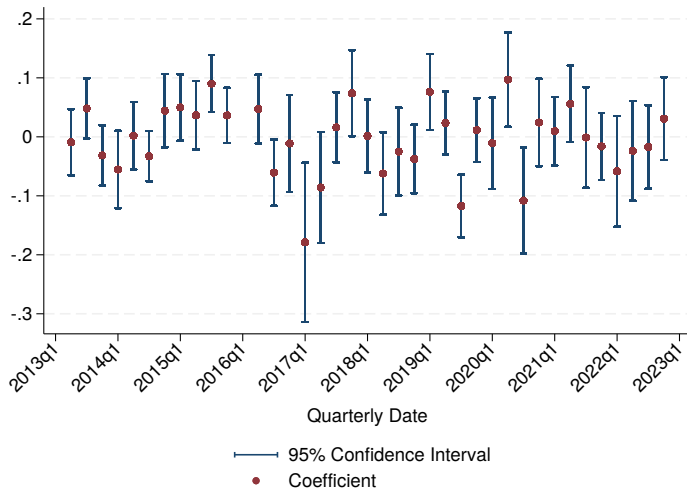
Set of all PF prime brokers ex Top 5 most distressed

► Covid-19: Limited Evidence of *Cross-Sectional* Credit Shock

► Evidence

► Return

We find several periods where hedge funds substitute away from shocked brokers



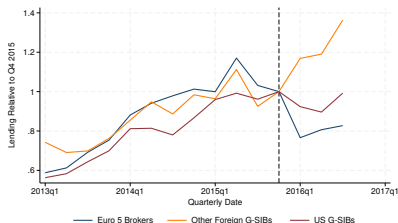
Archegos Default and Broker Losses

- ▶ In late March 2021, the large family office Archegos defaulted on its derivative positions with major broker-dealers.
- ▶ A disorderly liquidation process caused total losses exceeding \$10 billion.
- ▶ Breakdown of broker losses:
 - ▶ Brokers with losses (% of net worth): Credit Suisse (17.6%), Nomura (16.4%), UBS (1.4%), Morgan Stanley (0.7%), MUFG (0.2%), Mizuho (0.28%)
 - ▶ Brokers with no losses: Goldman Sachs, Deutsche Bank, Wells Fargo.
- ▶ Exposure Group: B/Ds with realized losses (“Archegos” or “Arch”)
 - ▶ Ex-ante lending share: about 33%

Aggregate Lending: Archegos vs E5

To test if distressed brokers reduced lending, we plot aggregate PBL^b by group:

(a) Euro 5



(b) Archegos



► Credit falls in both shocks

Did credit supply contract at distressed brokers?

To test for credit supply contraction, we regress:

$$\Delta \ln(PBL^{f,b}) = \alpha_f + \beta \cdot Treated^{f,b} + \epsilon^{f,b}$$

	Euro5 (2016Q1)			Archegos (2021Q2)		
	$\Delta \log(PBL^{f,b})$		$\frac{\Delta PBL^{f,b}}{NAV^f}$	$\Delta \log(PBL^{f,b})$		$\frac{\Delta PBL^{f,b}}{NAV^f}$
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Treated</i> ^{f,b}	-0.158*** (0.035)	-0.155*** (0.036)	-0.024** (0.009)	-0.079*** (0.028)	-0.085*** (0.028)	-0.024*** (0.008)
<i>R</i> ²	0.64	0.59	0.49	0.52	0.51	0.42
<i>N</i>	1,086	962	962	1,169	1,043	1,043
Fund FE	X	X	X	X	X	X
Sample	All	Large Eq	Large Eq	All	Large Eq	Large Eq

Standard errors in parentheses

^{*} $p < 0.10$, ^{**} $p < 0.05$, ^{***} $p < 0.01$

- ▶ Funds borrow 2.4 p.p. less in $\frac{PBL}{NAV}$ from each treated B/D
- ▶ **Yes, in both E5 and Archegos**

Can funds perfectly substitute to other brokers?

To test fund substitution capacity, we regress:

$$\Delta \ln(PBL^f_t) = \alpha + \beta \cdot BorrowFromAnyTreated^f_{t-1} + \epsilon^f$$

	Euro 5 (2016 Q1)			Archegos (2021 Q2)		
	$\Delta \log(PBL^f_t)$		$\frac{\Delta PBL^f_t}{NAV^f_t}$	$\Delta \log(PBL^f_t)$		$\frac{\Delta PBL^f_t}{NAV^f_t}$
	(1)	(2)	(3)	(4)	(5)	(6)
$BorrowFromAnyTreated^f_{t-1}$	-0.186*** (0.041)	-0.146*** (0.035)	-0.067*** (0.025)	-0.005 (0.034)	-0.021 (0.032)	0.096*** (0.030)
Intercept	0.074** (0.031)	0.046* (0.027)	0.038** (0.019)	0.061** (0.028)	0.073*** (0.027)	-0.024 (0.024)
R^2	0.058	0.048	0.227	0.050	0.070	0.119
N	493	415	415	463	398	398
StratFE	X	X	X	X	X	X
MinEquity		X	X		X	X

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

► Unlike during E5, HF's can substitute!

► Back

► Aggregate Substitution Tests

► E5: Full

► Arch: Full

► Uniqueness of Q1 2016

► Methodology

Market Clearing: HKM is neg and HFs sell stock

We estimate:

$$\Delta\omega_t^{s,i} = \alpha_q + \alpha_s + \beta\Delta\omega_t^{s,hf} + \epsilon_t^{s,i} \quad (12)$$

where $\omega_t^{s,i} = \frac{SharesOutstanding_t^{s,i}}{SharesOutstanding_t^s}$

	(1) BR	(2) HH	(3) IA	(4) LT	(5) PB	(6) HH+IA
Δ Mkt Share HF	0.014 (.)	-0.640 (.)	-0.373*** (0.059)	-0.008 (.)	-0.006 (0.010)	-1.008*** (0.025)
Observations	46864	47367	47362	45760	46809	47362
R-squared	0.219	0.864	0.810	0.274	0.288	0.696

Standard errors in parentheses

Sample: stock-quarters with HF selling (Δ Mkt Share HF < 0) and HKM < 0. Stock and quarter FE.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

► Return

Market Clearing: No Conditioning

We estimate:

$$\Delta\omega_t^{s,i} = \alpha_q + \alpha_s + \beta\Delta\omega_t^{s,hf} + \epsilon_t^{s,i} \quad (13)$$

where $\omega_t^{s,i} = \frac{\text{SharesOutstanding}_t^{s,i}}{\text{SharesOutstanding}_t^s}$

	BR	HH	IA	LT	PB	HH+IA
Δ Mkt Share HF	0.030*** (0.002)	-0.458*** (0.019)	-0.525*** (0.016)	-0.004*** (0.001)	-0.021*** (0.004)	-0.981*** (0.007)
Observations	228796	230710	230685	224290	228097	230685
R-squared	0.076	0.615	0.518	0.106	0.091	0.626

Standard errors in parentheses

Sample: stock-quarters with HF selling (Δ Mkt Share HF < 0) and HKM < 0. Stock and quarter FE.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

► Return

Testing Aggregate Implications

E5: Substitution capacity to healthier B/Ds is central to transmission

- ▶ The experiment suggests that transmission depends on hedge funds' ability to reallocate toward healthier broker-dealers.
- ▶ This distinction naturally separates:
 - ▶ **Idiosyncratic shocks:** substitution feasible [▶ Results](#)
 - ▶ **Common/systemic shocks:** substitution impaired
- ▶ This motivates two aggregate tests:
 1. Do periods of broad broker-dealer distress coincide with sell-offs and lower returns?
 2. Is transmission stronger when aggregate substitution capacity is lower?

Does substitution capacity amplify agg. relationship?

(1) Construct proxies from broker market equity:

$$AggHealth_t = \sum_b \Delta \ln(MarketEquity_t^b) \cdot LendingShr_{t-1}^b$$

$$ShareSpread_t = LendingShr_{t-1}^{\text{Top 25\% Healthy}} - LendingShr_{t-1}^{\text{Bottom 25\% Healthy}}$$

(2) Test specification:

$$\begin{aligned} \Delta Outcome_t = & \alpha + \beta_1 AggHealth_t + \beta_2 ShareSpread_t \\ & + \underbrace{\beta_3}_{\text{Amplification}} (AggHealth_t \times ShareSpread_t) + \epsilon_t \end{aligned}$$

$Outcome_t$: PB borrowing, equity exposure, HF-sorted returns.

► Details

Impaired substitution amplifies aggregate transmission

	$\Delta \ln(PBL_t)$	$\Delta \ln(Eq_t)$	$spread_t^{raw}$	$\varepsilon_{FF4,t}$
	(1)	(2)	(3)	(4)
$AggHealth_t$	0.112*	0.160**	0.176**	0.0138
	(1.73)	(2.40)	(2.65)	(0.38)
$ShareSpread_t$	0.0668	0.0533	0.0505	0.0456
	(1.54)	(1.35)	(1.04)	(1.17)
$AggHealth_t \times ShareSpread_t$	-1.050***	-1.080***	-0.786*	-0.562*
	(-3.45)	(-3.55)	(-1.72)	(-1.87)
Mktrf Ret	0.734***	0.833***		
	(7.60)	(8.43)		
R^2	0.835	0.879	0.380	0.124
N	39	39	39	39

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(3) Implied effect of a 10% $\downarrow$ in $AggHealth$ on $spread_t^{raw}$:

- ▶ Unconditional: -1.8%
- ▶ Easy substitution ($ShareSpread = +0.2$): -0.2%
- ▶ Hard substitution ($ShareSpread = -0.2$): -3.3%

Takeaway: the aggregate shock transmits mainly when hedge

Asymmetry and binding constraints

One interpretation of asymmetry: constraints bind in bad states.

- Test: does hedge fund borrowing revert after the shock?

$$\Delta_h PBL_{t+1} = \alpha + \beta HKM_t + \epsilon_t$$

$$\Delta_2 PBL_{t+1} = \alpha + \beta HKM_t + \beta_2 HKM_{t+1} + \epsilon_t$$

	Δ PBL (t)		Δ PBL (t+1)			Δ_2 PBL (t)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HKM Factor	0.146 (0.207)	-0.033 (0.096)	0.171 (0.246)	0.168 (0.266)	0.203 (0.177)	0.367 (0.320)	0.165 (0.293)	0.392 (0.239)
1(HKM < 0)	-0.013 (0.027)	0.010 (0.019)	-0.001 (0.031)	-0.011 (0.033)	-0.019 (0.029)	-0.005 (0.047)	0.009 (0.037)	-0.036 (0.042)
1(HKM < 0) × HKM Factor	0.548** (0.226)	0.257* (0.142)	-0.547* (0.281)	-0.819** (0.374)	-0.570*** (0.204)	0.068 (0.361)	-0.494 (0.390)	-0.001 (0.265)
Constant	0.042** (0.019)	0.001 (0.010)	-0.001 (0.022)	-0.002 (0.025)	0.020 (0.019)	0.041 (0.031)	-0.003 (0.029)	0.046* (0.026)
Observations	39	39	38	38	38	38	38	38
R-squared	0.547	0.814	0.103	0.141	0.626	0.169	0.408	0.559
Spec		MKT		MKT	HKM(t+1)		MKT	HKM(t+1)
Freq	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- Cols (6)–(8): consistent with borrowing reverting

Evidence from SCOOS: Do financing rates tighten?

- ▶ SCOOS: survey of senior credit officers at major broker-dealers
 - ▶ Key questions: collateral spreads over the relevant benchmark (effective financing rates) and demand
 - ▶ Only dataset with information on long, cash equity financing
- ▶ Net tightening proxy: $\frac{N_{\text{tighten}} - N_{\text{ease}}}{N_{\text{respondents}}}$
- ▶ Limitation: responses are timed mid-quarter
 - ▶ Study changes in t , $t + 1$, and the average of the two

HKM $\downarrow \implies$ tighter financing rates

	Tight(t)	Tight(t+1)	Average		
	(1)	(2)	(3)	(4)	(5)
HKM Factor	0.518 (0.381)	0.476* (0.251)	0.497** (0.214)	0.458 (0.293)	0.292 (0.225)
$\mathbb{1}(\text{HKM} < 0)$	0.026 (0.060)	0.007 (0.047)	0.016 (0.042)	0.027 (0.047)	-0.005 (0.041)
$\mathbb{1}(\text{HKM} < 0) \times \text{HKM Factor}$	-0.680* (0.401)	-1.656*** (0.313)	-1.168*** (0.242)	-1.081*** (0.345)	-1.031*** (0.245)
Constant	-0.063 (0.053)	-0.090*** (0.027)	-0.077** (0.031)	-0.086** (0.037)	-0.051 (0.031)
Observations	39	39	39	39	39
R-squared	0.043	0.441	0.272	0.278	0.371
Controls				MKTRF	Lagged Tightening

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- Financing rates tighter, lower quantities is consistent with credit supply

► Return

Higher exposure $\Rightarrow$ Higher sell-off

To validate that this measure captures abnormal sell-offs:

$$\Delta\% \text{ Held Euro5 HFs}_t^s = \alpha_t + \beta_1\% \text{ Held Euro5 HFs}_{t-1}^s + \beta_2\% \text{ Held Euro5 HFs}_{t-1}^s \times Q12016 + \epsilon_t^s$$

	$\Delta\%HeldEuro5HF_s$				
	(1)	(2)	(3)	(4)	(5)
Lag % Held Euro5 HF _s	-0.124*** (0.016)	-0.048*** (0.005)	-0.049*** (0.005)	-0.050*** (0.006)	-0.052*** (0.006)
Lag % Held Euro5 HF _s × I{Q12016}		-0.076*** (0.005)	-0.075*** (0.005)	-0.077*** (0.005)	-0.076*** (0.005)
Intercept	0.004*** (0.001)	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.004*** (0.000)
R^2	0.10	0.02	0.03	0.03	0.03
N	1,537	19,548	19,548	19,548	19,548
Q12016	X				
Qtr×YearFE			X		X
IndustryFE				X	X

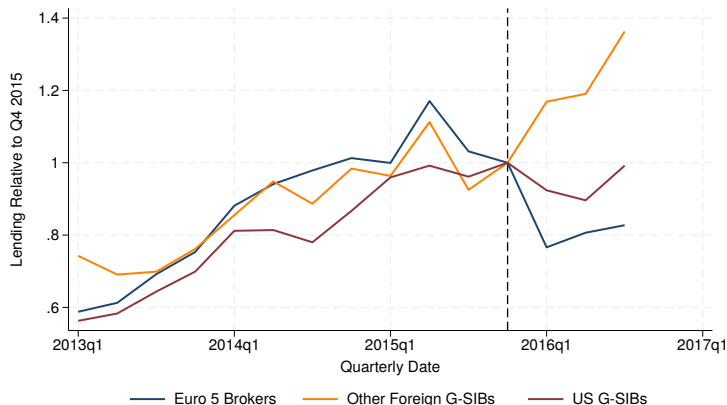
Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- ▶ Column (1): 1pp $\uparrow$ in E5 exposure $\Rightarrow$ 12.4bps $\uparrow$ sell-off

PB Lending from “treated” B/Ds ↓ in Q1 2016

(a) Euro 5



► Return

No evidence of transmission outside widespread distress

- ▶ Do shocks transmit when aggregate B/D health is stable?

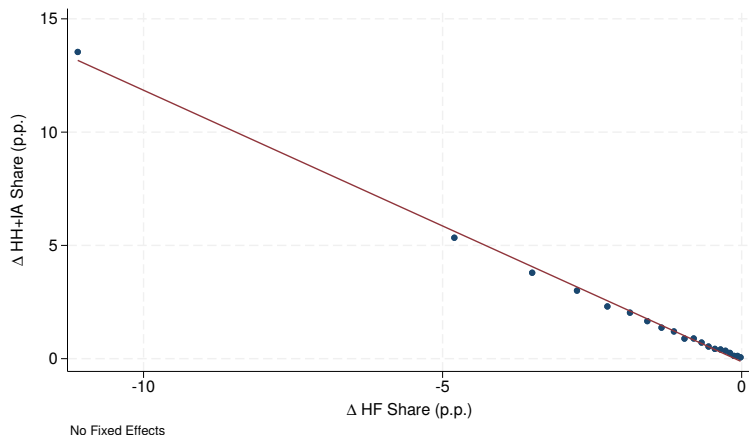
No evidence of transmission outside widespread distress

- ▶ Do shocks transmit when aggregate B/D health is stable?
- ▶ Run three distinct exercises:
 1. Repeat cross-sections of large B/D CDS spread changes
▶ Results
 2. Panels tests of same large B/D CDS spread changes
▶ Results
 3. Archegos event study of B/Ds with losses in Q1 2021
▶ Event Details

Across all cuts, B/Ds $\downarrow$ credit, but no evidence of hedge fund de-leveraging

⇒ **HF's substitute away from B/D distress** ▶ Return

Who absorbs? The less elastic!

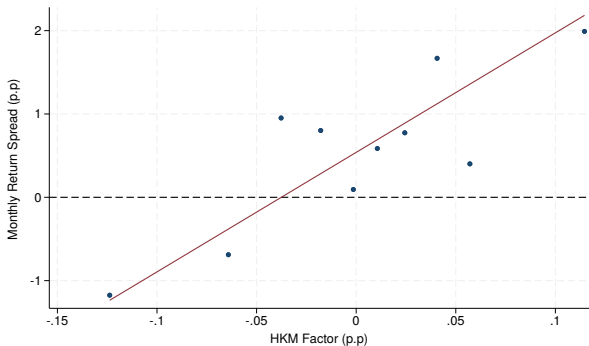


► IAs absorb 37%, HHs about 64%

Returns on stocks more owned by HFs ↓ during B/D ↓

Return Spreads

(Portfolios sorted on HF ownership)



- ▶ Robust to controlling for common factors
- ▶ Effect amplifies when agg. substitution capacity is limited

▶ Details

▶ Return