

AN ECONOMICS APPROACH TO SHORT SELLING IN FINANCIAL MARKETS

Heterogeneous Beliefs, Social Media as Signal Noise, and Asset Prices

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July 2026 · Very Preliminary — Comments Welcome

What We Do

- Motivation & contribution
- Related literature
- Data: S&P 500 panel & Reddit
- Stylized Facts: Liquidity, efficiency & stress
- Theoretical model & endogenous constraint
- Empirical results
- Portfolio construction (FF5)
- Policy implications & the Citron case study

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MarketsQuicktake

Why Activist Short Sellers Stir Up Controversy



Bankruptcy Law
June 4, 2024, 9:35 AM EDT

Short Sellers Fear Extinction in a Relentless Stock Market Rally

By Denitsa Tsekova and Carmen Reinicke

Jim Chanos quit after failing to raise capital. Carson Block's firm launched its first long-only fund. Andrew Left dubbed his kind "a dying breed."

These are bad times to be a bear on Wall Street.

After taking hits on multiple fronts, short sellers — who borrow and then sell stocks in a bid to profit from price declines — are in retreat. Thank the gravity-defying bull market, lingering regulatory threats, a day-trading horde randomly squeezing shares like GameStop Corp. ever higher, and more.

Under the finfluence – the effects of social-media-driven investment



DJ Khaled (2nd from left) and Floyd Mayweather (2nd from right). Photo: Kevork Djiansejian/Getty Images

 **By Howard Fischer | Moses & Singer**
May 2, 2024 • 4 min read

Short Selling and Social Media

- Short selling disciplines overpricing — pessimists who cannot short are effectively silenced, biasing valuations upward.
- Social media (Reddit, Twitter, StockTwits) can amplify investor sentiment at unprecedented speed and scale.
- *GameStop, January 2021: a coordinated retail short squeeze drove short interest from ~140% of float to near zero within days.*
- Open question: does social media make short selling more informative, or does it shut it down?
 - Our approach: social-media volume/noise should weaken short selling once attention becomes too intense. When social-media activity becomes very high, pessimists face greater noise/squeeze risk and reduce shorting

Preliminary Contributions

▸ Signal noise technology:

- social media volume n_t enters directly as private-signal noise; more posting degrades precision and amplifies disagreement. $\alpha > 0$ is the noise-elasticity parameter and captures the idea that a higher volume of social media posts — regardless of their informational content — adds noise to the interpretation of fundamental signals, because posts inject correlated but diverse interpretations, rumors, and sentiment that each investor partially incorporates into their private assessment.

▸ Endogenous constraint:

- pessimists optimally stop shorting once the speculative premium $\varphi(n_t)$ crosses a threshold $\bar{n}$. The key insight is that whether a pessimist wishes to hold a short position at all depends on whether the speculative premium — the anticipated cost of buying back the asset — makes shorting profitable at the margin.

▸ Propositions:

- **non-monotone count–SIR relation:** it reflects a tension between two channels: high coverage expands the investor pool and draws in more pessimists, stimulating short selling, but as high coverage accelerates information dissemination, it reduces residual mispricing and diminishes the incentive to short.
- premium-driven return discount
- discrete jumps in SI, Tobin's q and $E[r]$ at the threshold $\bar{n}$.

Related Literature

Heterogeneous Beliefs

- Miller (1977): constrained shorting → overpricing
- Harrison & Kreps (1978): resale-option premium
- Scheinkman & Xiong (2003): Disagreement and overconfidence

Short Interest & Returns

- Asquith & Meulbroek (1995): high short interest successfully predicts future negative stock performance.
- Rapach, Ringgenberg & Zhou (2016): short interest is a predictor of the equity risk premium
- Chen, Da & Huang (2022): SI efficiency slope

Social Media & Psychology

- Bollen, Mao & Zeng (2011): Twitter sentiment
- Cai et al. (2023): pump-and-dump patterns
- Loustau, Magnus & Sparkman (2025): contrarianism
- Kurucak (2025): response time as a non-verbal signal

Data: S&P 500 Panel and Reddit Social Media

- ▶ **Test assets:**

- 689 unique S&P 500 firms, monthly, July 2008–December 2022 (119,713 firm-months); spans GFC, 2010s bull market, COVID, GameStop, 2022 rate hikes.

- ▶ **Short-selling measures:**

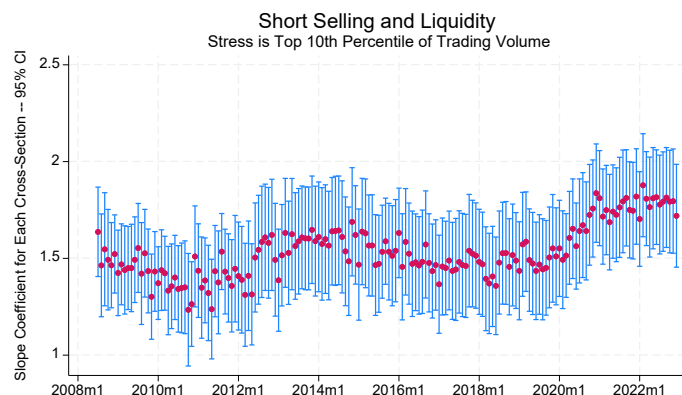
- Short Interest ($SI_{i,t}$) and Short Interest Ratio ($SIR_{i,t} = SI / \text{avg. daily volume}$, the "days-to-cover" concept); both log-transformed.

- ▶ **Social media:**

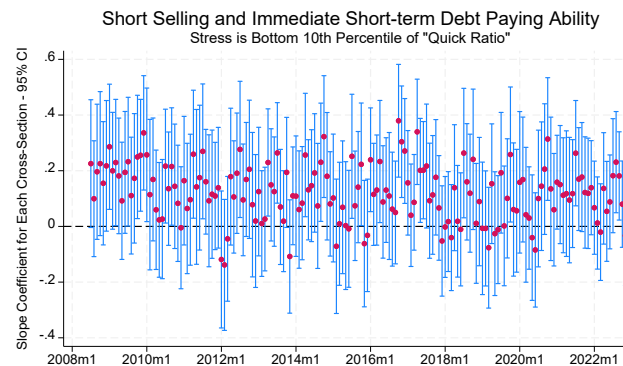
- 3,390,923 Reddit submissions (11 investing subreddits, Pushshift archive); NTUSD-Fin sentiment lexicon gives lcount, bullscore, bearscore, and bull–bear score.

Stylized Facts: Do Short Sellers Target the Right Firms?

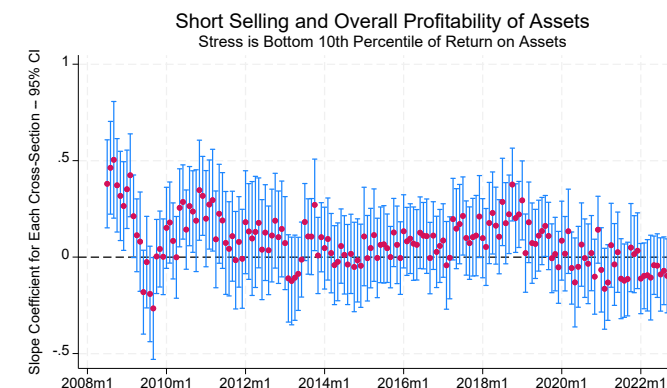
Liquidity: SI and SIR both rise significantly with trading volume — short sellers prefer liquid markets



Financial stress: Short selling concentrates in firms with weak quick ratios and low ROA — consistent with informed, efficiency-enhancing activity.



Overpricing: Evidence on high P/E targeting is positive but imprecisely estimated.



Theory

Representative-investor CARA
benchmark

Heterogeneous beliefs & the
mispricing formula

Kalman-filter beliefs under
social-media noise

Endogenous short-sales
constraint & threshold $\bar{n}$

Representative-Investor CARA Benchmark

- Single risky asset; terminal dividend $F(T) \sim N(\mu, \sigma^2_F)$; representative investor with CARA risk aversion λ .
- FOC on mean-variance objective gives optimal holding x^* , and market clearing pins down price.

$$x^* = (\mu - P(t) \cdot r) / (\lambda \sigma^2_F)$$

$$\mu - p_0 = \lambda \sigma^2_F Q \quad (1)$$

The risk premium equals risk aversion $\times$ payoff variance $\times$ shares outstanding Q .

Heterogeneous Beliefs and the Mispricing Formula

- Beliefs $\mu_i \sim U(\kappa_L, \kappa_H)$ across a continuum of CARA investors.
- Unrestricted shorting: price aggregates the full belief distribution.
- Shorting banned: only $\mu_i \geq p_0$ participate — the optimist-dominated right tail prices the asset.

$$p_0^* = (\kappa_H + \kappa_L)/2 - \lambda \sigma^2_F Q \quad (3)$$

$$p_0(C) = \kappa_H - \sqrt{[2 \lambda \sigma^2_F (\kappa_H - \kappa_L) Q]} \quad (4)$$

$$\Delta p_0 \approx (\kappa_H - \kappa_L)/2 \propto \kappa_H - \kappa_L \quad (6)$$

Mispricing under a shorting ban is proportional to the breadth of belief disagreement.

Social Media as Private-Signal Noise

- Dividend: $dF = \mu dt + \sigma_F dB_F$. Private signal: $dS_k = F dt + \sigma_S(n_t) dB_k$, $k \in \{H, L\}$.
- Noise specification: $\sigma_S(n_t) = \bar{\sigma}_S \cdot \exp(\alpha n_t)$, strictly increasing and convex in volume of social media n_t .
- Given the linear-Gaussian structure, each investor applies the Kalman filter to form posterior beliefs about $F(t)$
- Steady-state Kalman gain falls as posting rises — each new signal carries less weight.

$$\sigma_S(n_t) = \bar{\sigma}_S \cdot \exp(\alpha n_t) \quad (9)$$

$$\kappa_k(n_t) = (\sigma_F / \bar{\sigma}_S) \cdot \exp(-\alpha n_t) \quad (13)$$

As $n_t \rightarrow \infty$, the Kalman gain $\rightarrow 0$: signals become pure noise and beliefs stop updating.

Disagreement Dynamics and the Speculative Premium

- Disagreement about posteriors $\Delta(t) \equiv \hat{F}_H - \hat{F}_L$ follows a mean-reverting process (Ornstein–Uhlenbeck); volatility $\sigma_\Delta(n_t)$ rises with social media volume.
- In the constrained regime, only optimists hold the asset — price embeds a speculative premium $\varphi(t)$ above fundamental value.

$$d\Delta = -\theta \Delta dt + \sigma_\Delta(n_t) dW_\Delta \quad (17)$$

$$\varphi(t) = (\kappa_L / r) \cdot \{ \Delta / (\kappa_H + \kappa_L) - \lambda \sigma_F^2 / [\kappa_H(\kappa_H + \kappa_L)] \} \quad (22)$$

$\theta > 0$ is the speed of mean reversion

$\varphi > 0 \Leftrightarrow$ disagreement Δ exceeds $\lambda \sigma_F^2 / \kappa_H$, and $\partial\varphi/\partial n_t > 0$: the premium rises with posting volume n .

Deriving the Threshold $\bar{n}$

- Pessimists short only if the expected gain outweighs the inflated buy-back cost implied by the speculative premium $\varphi(t)$.
- The constraint binds once the premium reaches the discounted belief gap.

$$\varphi \geq \Delta(t)/r - \lambda \sigma^2 F / [r \kappa_H] \approx \Delta(t)/r \quad (30)$$

$$\varphi(\Delta, \kappa_H - \kappa_L, \sigma \Delta(\bar{n}), t) = \Delta(t)/r \quad (31)$$

$n_t < \bar{n} \rightarrow$ Regime U
constraint slack, pessimists short freely



$n_t \geq \bar{n} \rightarrow$ Regime C
premium overwhelms shorting; constraint binds

Comparative Statics of the Threshold

Differential	Sign	Interpretation
$\partial \bar{n} / \partial \Delta$	> 0	Larger belief gap $\Rightarrow$ higher volume needed to deter shorting
$\partial \bar{n} / \partial (\kappa_H - \kappa_L)$	< 0	More net optimism $\Rightarrow$ premium inflates faster $\Rightarrow$ lower threshold
$\partial \bar{n} / \partial \alpha$	< 0	Higher noise-elasticity $\Rightarrow$ threshold reached sooner
$\partial \bar{n} / \partial C$	> 0	Denser contrarian pool $\Rightarrow$ stabilizes market, delays Regime C

Threshold impact

Variable	Regime U ($n_t < \bar{n}$)	Regime C ($n_t \geq \bar{n}$)
Price $P(t)$	$P^*(t)$ [fundamental]	$P^*(t) + \varphi(t)$
Premium ϕ	0	$\varphi > 0, \partial\varphi/\partial n_t > 0$
Short interest SI	$\kappa_H \kappa_L \Delta / [(\kappa_H + \kappa_L) \lambda \sigma_F^2] > 0$	0 (constraint binds)
Tobin's q	= 1	> 1
Expected return $E[r]$	r_{CAPM}	$r_{CAPM} - \varphi/P < r_{CAPM}^*$
Constraint	Slack ($x_L < 0$ feasible)	Binds ($x_L = 0$ optimal)

*stocks in the constrained/high-attention regime overpriced
because pessimists withdraw and stocks have lower future returns.

Three Propositions

Proposition I

Non-monotone count–SIR relationship

Weakly increasing below $\bar{n}$; collapses to zero (constant) above $\bar{n}$ — a kink at the threshold $\bar{n}$

- Run Hansen (2000) threshold regressions, by company.

Companies that fit the proposition:

- Apple
- Best Buy
- Boeing
- Intel
- JPMorgan Chase
- MGM Resorts
- Morgan Stanley
- Nasdaq Inc
- Starbucks
- Walmart

Proposition II

Premium-driven return discount

In Regime C, $E[r] = r_{\text{CAPM}} - \phi \cdot r / P^{\text{C}} < r_{\text{CAPM}}$, falling further as net optimism $\kappa_{\text{H}} - \kappa_{\text{L}}$ rises.

Proposition III

Regime switching at $\bar{n}$

$\bar{n}$ shifts with Δ , $\kappa_{\text{H}} - \kappa_{\text{L}}$, α , β and contrarian density C; SI, q, $E[r]$ all jump discretely at $\bar{n}$.

Empirics: Correlations and Panel Regressions

- **Contemporaneous correlations:**
 - lcount and SIR: -0.143^{***} ; bull–bear and SIR: -0.032^{***}
- **Panel regressions, $\log(\text{SIR})$:**
 - contemporaneous social media count (SM) coefficient -0.110^{***} to -0.137^{***} ; lagged partial reversal ($+0.086^{***}$) as stocks re-enter Regime U; AR(1) persistence 0.675^{***} .
- **Granger causality:**
 - lcount $\rightarrow$ SIR at 1 lag; bidirectional at 3–6 lags, consistent with a feedback loop between attention and regime transitions.

Granger Causality extended: Does Social-Media Silence Predict Short Interest?

- ▶ Motivated by Kurucak (2025): managerial response time (the analyst-question-to-answer delay) is an informative non-verbal signal.
- ▶ **The Reddit data are sparse: Many zero periods for each company: Crowd-level analog — RESP (response time):**
 - length of a firm's preceding run of zero Reddit posting ("silence"), constructed directly as time spells.
- ▶ Test: panel local projections (Jordà-style), 3 lags each direction, $h = 2, 3, 4$, sector-clustered SEs.

Horizon h	Resp $\rightarrow$ SIR $F(3,25)$	p-value	SIR $\rightarrow$ Resp $F(3,25)$	p-value
2	<i>4.65**</i>	<i>0.010</i>	4.24**	<i>0.015</i>
3	<i>0.61</i>	<i>0.615</i>	6.71***	<i>0.002</i>
4	<i>1.88</i>	<i>0.158</i>	8.75***	<i>0.000</i>

Joint significance only at $h=2$ for Resp $\rightarrow$ SIR; SIR $\rightarrow$ Resp is significant and strengthening at every horizon, with uniformly negative lag coefficients.

Short Interest Leads Attention, Not the Reverse

- **Asymmetric causality:**

- silence $\rightarrow$ SIR is fragile (significant only at $h=2$); SIR $\rightarrow$ silence is robust and strengthens through $h=4$.

- **Sign:**

- higher short interest predicts a faster return of social-media attention (shorter subsequent silence) — a recognition/contagion effect, not latent disagreement building up quietly.

- **Implication for the model:**

- reduced-form result on the direction of the attention–short-interest feedback loop.
 - Is SIR a determinant of subsequent social media attention?

Firm Value and Cross-Sectional Pricing

- **Tobin's q :**
 - no contemporaneous bull–bear effect, but a delayed negative effect at lags 2–3 as n_t mean-reverts below $\bar{n}$.
- **Fama–MacBeth cross-sectional regressions:**
 - positive, significant price of short-interest risk (λ_{SI}) — long–short spread between Regime U (high SI) and Regime C ($SI=0$) stocks matches the lower expected-return gap.
- **Quantile regressions:**
 - the bull–bear effect on SIR is less negative at upper SIR quantiles, where the constraint is already binding.

Fama–French Five-Factor Framework

- Decompose excess returns into MKT-RF, SMB, HML, RMW, and CMA exposures.
- Double-sort: short interest into 3 tiers (Low / Medium / High) × social-media score into 2 tiers (Low / High) → 6 portfolios.
- Key test portfolio diff10: medium-minus-low short interest return spread, rebalanced monthly.

$$R_{p,t} - R_{f,t} = \alpha + \beta_{MKT}(MKT-RF_t) + \beta_{SMB}(SMB_t) + \beta_{HML}(HML_t) + \beta_{RMW}(RMW_t) + \beta_{CMA}(CMA_t) + \varepsilon_t$$

Double-Sort Portfolio Alphas

Portfolio	Alpha (%/mo.)	Regime / Channel
Low SI, Low BB	−0.998***	premium inflated, both channels
Med-Low SI, Low BB	+best Sharpe/Sortino	Regime U/C straddle
Med-Low SI, Low Count	+1.07%*** (diff10)	Building recognition

Best portfolio: medium-minus-low SIR, low bull–bear, low count — Sharpe 0.531, Sortino 1.178

Regulation: Why Hard Restrictions on Short Selling are Inefficient

- **Mispricing under a ban is $\Delta p_0 \propto (\kappa_H - \kappa_L)$:**
 - the wider the belief spread, the larger the cost of silencing pessimists.
- **Bans $\approx$ forcing all stocks into Regime C:**
 - equivalent to raising the effective threshold $\bar{n}$ exogenously, regardless of actual social media volume.
- **Evidence from 2008 SEC ban & EU restrictions:**
 - wider bid-ask spreads, greater price impact, and more pronounced subsequent declines as suppressed information surfaced later.

Case Study: Citron - Andrew Left – “Social Media Securities Fraud”

- ▶ June 1, 2026: jury convicted activist short seller Andrew Left (Citron Research) on 13 of 17 counts of securities fraud — first conviction on a "***social-media securities fraud***" argument.
- ▶ Alleged scheme: Left publicized long/short positions on CNBC, Bloomberg, social media, then traded opposite to (or quickly reversed) his stated position.
- ▶ ≈\$21M illicit profit across 26+ episodes, 23 companies; target stocks moved >12% on average after his statements.

Target	Position	Allegation	Profit	Verdict
<i>NVIDIA (NVDA)</i>	3-day calls	Misleading half-truths from Citron	\$930K	Guilty
<i>Tesla (TSLA)</i>	3-day calls	Misleading half-truths from Citron	\$7,600K	Guilty
<i>Twitter (TWTR)</i>	Short	Misleading half-truths from Citron	\$2,000K	Guilty
<i>Beyond Meat (BYND)</i>	Short + puts	Misrepresented position in interview	—	Not Guilty
<i>General Electric (GE)</i>	Purchase	Falsely claimed no hedge-fund pay	\$70K	Not Guilty

Illustrative: NVIDIA, Nov. 2018 — Citron publicly went long at a \$165 target; ~2 hours later, with NVDA near \$150, Left had already exited for a \$960K profit.

Consequences: Informational vs. Manipulative Social-Media Signals

- **Maps onto our own channels?**
 - a Citron report is a discrete, high-volume shock to n_t — moving price via the same $\sigma_S(n_t)$ and φ mechanisms
- **What our model can't separate:**
 - Icount and bull-bear treat any attention spike symmetrically, whether it reflects sincere dispersed disagreement (μ_i) or a single account's fabricated, position-reversed signal.
- **Policy takeaway**
 - the fraud here is misrepresenting one's own position, not short selling itself. Prosecuting manufactured n_t shocks preserves the information content of authentic ones — a narrower, cheaper remedy than a blanket short-sale ban.

In Summary

- ▶ Short selling tracks liquidity and concentrates in financially stressed firms — informed, efficiency-enhancing activity.
- ▶ Social media's effect on short interest is non-monotone, resolved by the endogenous threshold $\bar{n}$ between an initial recognition effect and a subsequent transparency effect.
- ▶ A medium minus low short interest and low social media strategy earns a significant alpha of $\approx 1.07\%$, Sharpe 0.664, Sortino 1.151 — not spanned by the FF5 factors.

Thank You

Comments welcome · Marcelo Bianconi (Tufts) ·
Federico Esposito (Milano-Bicocca)

Financial Account for the construction of Erechtheion
408/407 BC

