High Frequency Trading and the 2008 Shorting Ban

Using the ban to estimate HFT's impact on markets challenge is it also impacted other short sellers

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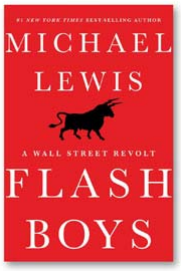


Outline of Talk

- Brief background
  - 2008 Short Sale Ban as an instrument for evaluating HFT
    - Extend work on Ban's effects, e.g., BJZ (RFS 2013)
    - Must control for confounding events
    - Disentangling effects of short selling by HFT and non-HFT
    - Focus on ban's cross sectional effect
      - Multivariate diff-in-diff
      - An IV approach for when an event (technological or regulatory shock) impacts multiple groups of traders. How can we separately evaluate the causal channels?
        - Brings together having data identifying multiple investors'/traders' activity and "model free" causality
  - Some thoughts on the development of HFT
    - The paper's results in context of long term trends

The old trading floor, NYSE 1873

A great day at the New York Stock Exchange, 1878

More recent trading floor

4

Current NYSE trading floor

Is better suited for hosting parties and TV commentators?

5

Current trading floor

Securities Market

Algorithmic and High-Frequency Trading

- Algo Trade Definition: "The use of computer algorithms to manage the trading process."
  (Hendershott et al. 2011); HFT similar, but for short holding periods

6

Some Potential Impacts

- Marginal cost of monitoring and placing orders is ~0
- HFTs informed about public information (news arrival)
  - Reduce adverse selection by quoting more efficient prices
  - Increase adverse selection by picking off inefficient prices
- HFTs informed about public information (institutional trading)
  - Decrease pricing errors by incorporating this information quickly
  - Increase pricing errors by trading ahead of future institutional trading
    - Increase the temporary impact of institutions trades, by making prices more efficient?
- Most of these effects are naturally done through liquidity demand or liquidity supply

Evaluating market structure

- Welfare analysis in microstructure?
  - Specifying and aggregating utility functions is hard
  - Price signals for the economy (HFT?)
  - Gains from trade (risk sharing)
  - "Fairness"?
  - Simple measures with intuitive motivations?
- Liquidity and price efficiency?
  - Do bid-ask spreads measure anything important?
  - What sort of price efficiency do we care about?
    - Efficient prices for trading v. resource allocation
    - Does price inefficiency relate to institutional trading costs?

Ban: 9/15-9/19, 2008: quite a week

Mon 15 Sep

Lehman Files for Bankruptcy; Merrill is Sold

Tue 16 Sep: AIG teeters

Fed's $85 Billion Loan Rescues Insurer

Wed 17 Sep: MS falls almost 25%

As Fears Grow, Wall St. Titans See Shares Fall

Thu 18 Sep

Vast Bailout by U.S. Proposed in Bid to Stem Financial Crisis

Fri 19 Sep:

S.E.C. Temporarily Blocks Short Sales of Financial Stocks

Empirical design

- We examine effects of the shorting ban on:
  - Shorting activity, HFT and non-HFT
  - Liquidity and price efficiency
- Methodology
  - Banned firms matched to similar non-banned stocks
  - "Treatment" group vs. "control" group
  - Ban and cross sections variables as IV for HFT and non-HFT activity
    - Multivariate diff-in-diff
  - Lagged volatility, XLF (financial sector ETF) volatility as controls

The shorting ban was far-reaching…

- Stocks affected:
  - Initially applied to 797 financial stocks
  - About 200 more firms asked and were added to the ban list later (including GE, GM, IBM)
- Timeline
  - Announced late evening Thu 18 Sep
  - Effective Fri 19 Sep
  - Could be extended for a total of 30 calendar days
  - Shorting resumed on Thu 9 Oct

…but had a number of holes (by design)

- Exemptions
  - Registered market makers, block positioners, or other market makers in the over-the-counter market
  - Options market-makers
  - Nobody had to close a pre-existing short position
- Investors can still take a bearish position via:
  - Buying puts
  - Buying protection in credit default swaps
  - Shorting ETFs
  - Total return swaps
  - Shorting equities in a jurisdiction where shorting isn't banned

Confounding events on initiation

- Fri 19 Sep was a very unusual day (so we omit it or use as a control):
  - Triple witching day (expirations for index futures, index options, equity options)
  - U.S. shorting ban and other short sale reporting requirements
  - Treasury secretary Henry Paulson announces creation of what would soon become known as TARP (Troubled Asset Relief Program)
  - Treasury announces money-market fund guarantee program
  - Federal Reserve announces asset-backed CP lending program
  - Federal Reserve widens range of allowable collateral for existing lending programs
  - Breathtaking intraday volatility
  - **Exclude this day;** or try to use information in cross-sectional returns

Data

- We merge data from multiple sources.
  - List of affected stocks from **SEC** and **exchanges**
  - Various stock characteristics from **CRSP**
  - Intraday data on trades and quotes from **SIRCA**
  - Proprietary **Nasdaq** intraday short sale data with HFT flag
- Sample
  - August 1st, 2008 – October 31st, 2008
  - 987 firms (848 on initial list, 139 added later) banned
  - We have data for all BJZ firms
  - We drop stocks that trade on fewer than 60 days
  - Left with **422** Banned and **422** control stocks

Liquidity & price efficiency measures

- Trading cost (bid-ask) spread measures:
  - quoted spread (ask price minus bid price)
  - effective spread (trade price minus bid-ask midprice) = $\frac{|P_{i,t} - M_{i,t}|}{M_{i,t}}$
  - spread decomposition based on trade sign and price changes
    - price impact (adverse selection)
    - realized spread (fixed part of spread)
- Pricing Errors
  - Hasbrouck (1993) Vector Autoregression (VAR) approach to estimating the efficient price
  - The difference between the observe midquote and estimate efficient midquote is referred to as the pricing error
    - Standard deviation of this is a measure of price efficiency

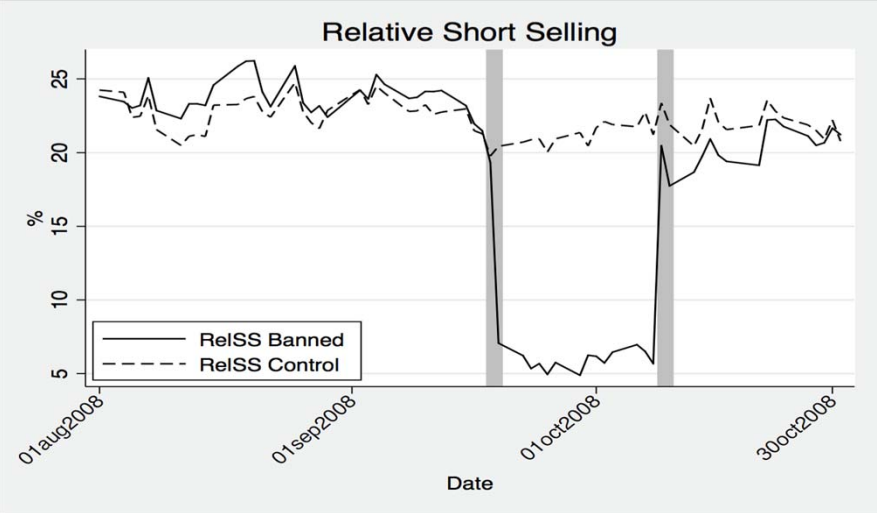
Descriptive Statistics

Table 1

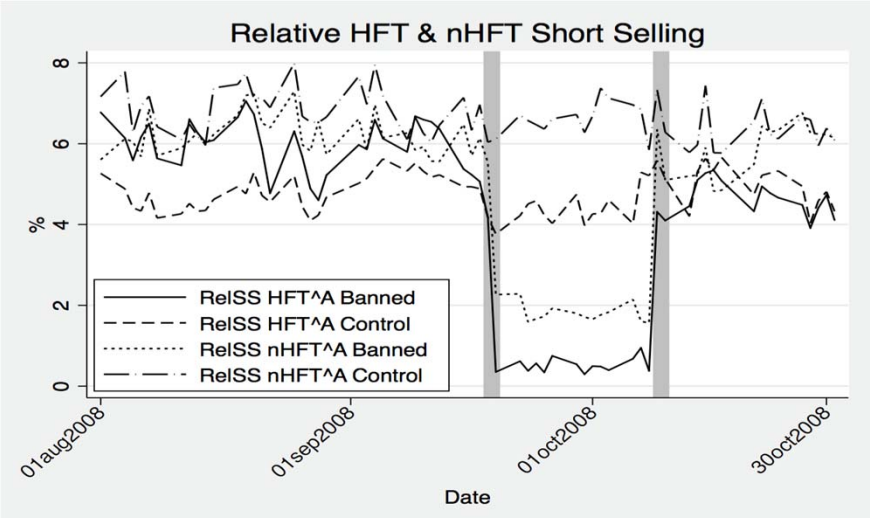
		Banned			Control		
Variables	Units	Pre-Ban	Ban	Post-Ban	Pre-Ban	Ban	Post-Ban
No. of Stocks		422	422	422	422	422	422
Nasdaq Volume	$100,000	226.10	168.40	208.50	163.50	174.00	173.50
Quoted Spread	Bps.	27.58	60.09	61.10	27.50	39.85	55.65
Effective Spread	Bps.	20.46	45.98	44.09	19.84	29.01	40.80
Realized Spread	Bps.	6.55	20.13	16.55	7.63	11.45	16.33
Price Impact	Bps.	13.91	25.85	27.54	12.21	17.56	24.47
Std. Dev. Pricing Error	100	0.35	0.72	0.63	0.34	0.49	0.60

- Good match in terms of spreads
- Relatively large stocks
- Large increase in spreads for banned and control stocks
- Larger increase for banned stocks

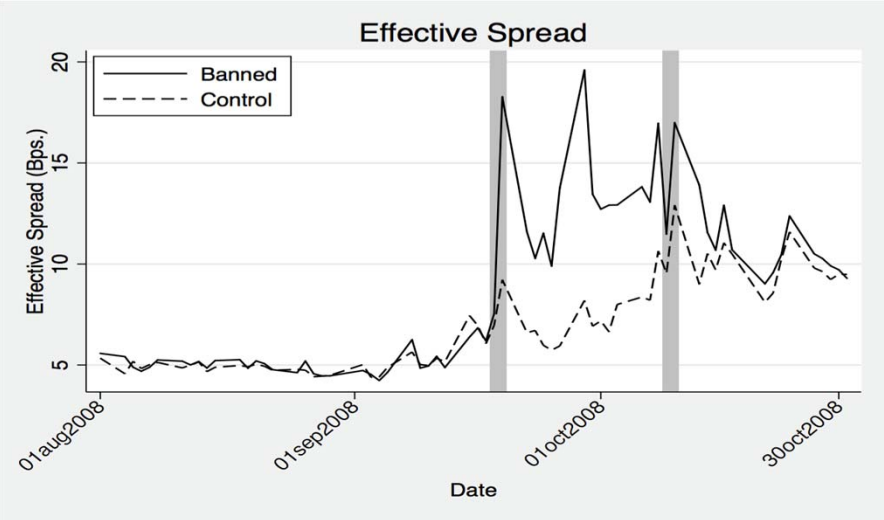
Effect of the Ban (as in BJZ)



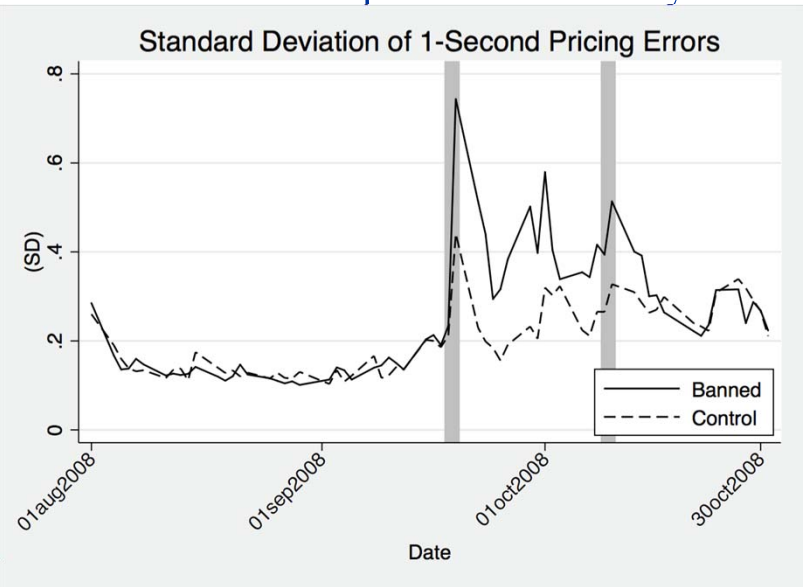
Effect of the Ban



Effect of Ban on liquidity/spreads



Effect of Ban on price efficiency



Hasbrouck (1993) pricing errors (deviations from efficient price)

Ban's effects liquidity & price efficiency

Panel A: All Stocks

	Quoted Spread	Effective Spread	Realized Spread	Price Impact	Std. Dev. Pricing Error
Ban	35.67***	31.34***	21.41***	9.93***	0.29***
Ban*Mcap	-4.50***	-4.58***	-3.18***	-1.40*	-0.05***
Ban*Option	-24.17***	-18.96***	-13.66***	-5.29***	-0.09**
Ban*Price	-0.04	-0.06	-0.05	-0.01	-0.00
Mcap	-17.92***	-20.03***	-2.04	-17.99***	-0.34***
Price	0.96***	0.88***	0.16	0.71***	0.01***
Rtn. Std. Dev.(t-1)	1.28***	0.96***	0.52***	0.44***	0.02***
XLF Rtn. Std. Dev.	4.27***	3.69***	1.11**	2.57***	0.03***
Ban*XLF Rtn. Std. Dev.	1.59	0.59	-0.41	1.00*	0.02**
Pre Period	-6.57***	-4.10***	-2.12**	-1.99*	-0.07**
Post Period	10.32***	6.25***	3.61***	2.64*	-0.01
Stock FEs	Yes	Yes	Yes	Yes	Yes
N	52,111	52,111	52,111	52,111	52,111
Adj. R^2	0.64	0.54	0.24	0.27	0.28

The Ban as an instrument

- A good instrument is exogenous: $\text{cov}(ban, \varepsilon) = 0$

This is often referred to as the exclusion restriction

- Also ban is relevant, i.e. correlated with regressor (short-selling)
- This implies that for the ban to be a valid instrument is must affect spread (or price efficiency) but only indirectly through trading.
  - It was a short sale ban, what other effect did it have?
- The ban was implemented by the regulator (i.e. exogenous?)
- What to worry about? Something else correlated with the selection of stocks for the ban, e.g., that the ban occurred in financial stocks
  - BJZ show Ban's effects hold only on removal, for stocks added later, matched by industry
  - In general, worried the informational environment is different for banned stocks
    - Volatility controls, use stock returns on ban's introduction or during the ban as a control

Instrumental Variable Approach

Two-stage least squares:

Stage 1: Relss predicted by the ban and not predicted by the ban

$$Relss_{it} = \alpha_i + \alpha_1 Ban_{it} + \beta_1 Control_{it} + \mu_{it}$$

Stage 2: Use predicted value of $Relss_{it}$ to estimate the causal impact

$$Spreads_{it} = \gamma_i + \gamma_1 Relss\text{-}hat_{it} + \phi_1 Control_{it} + \nu_{it}$$

- We also interact the ban with other exogenous variables (not determined jointly or affected directly by trading)
  - Pre-period Ln(Market Capitalization)
  - Pre-period Price
  - Pre-period Options Trading Status
- A number of control variables in addition to stock FEs
  - Particularly lagged stock volatility and contemporaneous XLF vol.

Ban's effects on shorting selling

	RelSS HFT^A	RelSS $nHFT^A$	RelSS HFT^D	RelSS HFT^S	Rel HFT^A
Ban	-1.95***	-5.56***	-0.79***	-1.16***	-5.14***
Ban*Mcap	-1.14***	0.08	-0.54***	-0.61***	-1.72***
Ban*Option	-1.53***	-3.03***	-1.89***	0.36***	0.03
Ban*Price	0.01**	-0.00	-0.01	0.01***	0.01
Mcap	0.57***	1.06**	0.39**	0.18	3.57***
Price	-0.01	-0.04***	0.00	-0.01***	-0.05***
Rtn. Std. Dev.(t-1)	0.00	-0.02**	-0.00	0.00	0.01
XLF Rtn. Std. Dev.	0.29***	-0.28	0.24***	0.05	1.14***
Ban*XLF Rtn. Std. Dev.	-0.61***	-0.10	-0.41***	-0.19***	-1.31***
Pre Period	0.59***	1.45***	0.53***	0.06	0.89**
Post Period	-0.01	0.67*	0.18	-0.19***	0.24
Stock FEs	Yes	Yes	Yes	Yes	Yes
N	52,111	52,111	52,111	52,111	52,111
Adj. R^2	0.71	0.29	0.64	0.62	0.81

Instruments are too weak to disentangle $nHFT^S$ and $nHFT^D$

Effects of HFT and nHFT short-selling

Panel A: All Stocks

	Quoted Spread	Effective Spread	Realized Spread	Price Impact	Std. Dev. Pricing Error
RelSS HFT^{D}	18.14***	16.08***	11.36***	4.72***	0.12***
RelSS HFT^{S}	-8.96**	-7.12**	-5.11**	-2.01	-0.03
RelSS nHFT^{A}	-6.86***	-6.26***	-4.28***	-1.98***	-0.06***
Mcap	-17.29***	-19.19***	-1.56	-17.64***	-0.32***
Price	0.61***	0.55***	-0.06	0.61***	0.00***
Rtn. Std. Dev.(t-1)	1.17***	0.85***	0.45***	0.40***	0.01***
XLF Rtn. Std. Dev.	-1.49	-1.51	-2.52**	1.00	-0.02
Ban*XLF Rtn. Std. Dev.	6.76***	5.32***	2.93**	2.39***	0.06***
Pre Period	-6.14*	-3.41	-1.82	-1.59	-0.05
Post Period	9.62**	5.98	3.32	2.66	-0.00

- A 1% increase in relative HFT demanding short-selling causes a 18.14 basis point increase in spreads!
- The same increase in relative HFT supplying short-selling causes a 8.96 decrease in spreads!

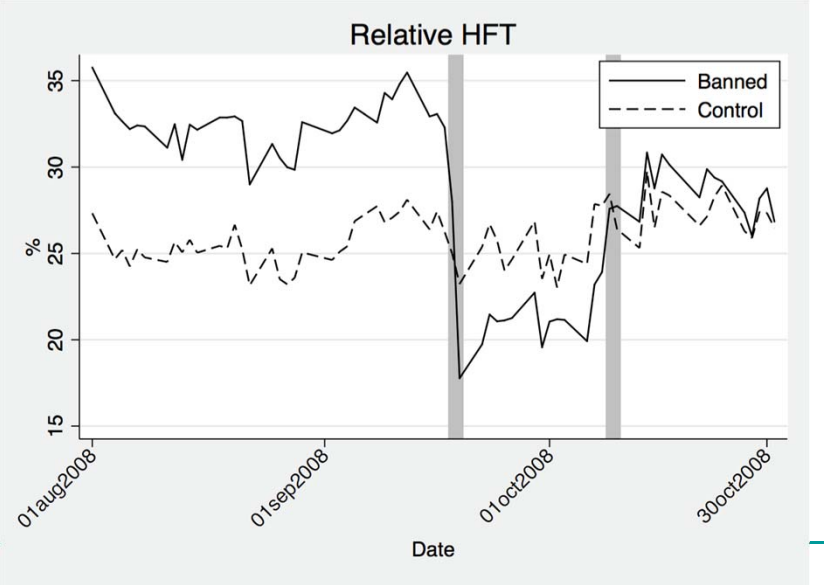
HFT more generally?

Panel A: All Stocks

	Quoted Spread	Effective Spread	Realized Spread	Price Impact	Std. Dev. Pricing Error
Rel HFT^{A}	4.37***	4.25***	2.99***	1.26**	0.04***
RelSS nHFT^{A}	-5.03***	-4.83***	-3.28***	-1.56***	-0.05***
Mcap	-27.36***	-29.18***	-8.58	-20.61***	-0.42***
Price	0.95***	0.85***	0.15	0.70***	0.01***
Rtn. Std. Dev.(t-1)	1.14***	0.82***	0.43***	0.39***	0.01***
XLF Rtn. Std. Dev.	-2.24	-2.62	-3.29*	0.67	-0.03
Ban*XLF Rtn. Std. Dev.	7.11**	5.94**	3.36*	2.57***	0.07***
Pre Period	-5.99	-3.27	-1.71	-1.56	-0.05
Post Period	9.76**	6.00	3.35	2.65	-0.01

- A 1% increase in relative HFT causes a 4.37 basis point increase in spreads
- The same increase in relative nHFT short-selling causes a 5.03 basis point decrease

Relative HFT (% of volume)



Summary

- Uses Short Sale Ban to study the effect of HFT
- Short sale ban & differential cross-sectional impact in IV
  - How HFT affects liquidity and price efficiency
- HFT short selling liquidity demand decreases liquidity and price efficiency
- nHFT shorting activity improves liquidity and price efficiency
- Most conservative interpretation:
  - Some component of HFT is harmful and another is beneficial

IV discussion/extensions

- Already controlling for changes in financial sector volatility (ETF volatility)
- Could there be a differential cross-sectional impact that is correlated with instruments (omitted variable)?
  - Use first of day of ban's stock return as an instrument
  - Results remain similar
- Does the ban affect firms' information environment?
  - A channel not through short selling
  - Make firms' efficient price volatility endogenous
  - Results remain similar

General IV caveats

- Measures local average treatment effects (LATE)
  - Impact on HFT is large
  - It is not a small treatment effect
    - But, large amount of HFT remains
- Is LATE representative?
  - Not entirely as nHFT liquidity demand and supply impacts are not symmetric with overall HFT demand and supply activity
  - Also, market maker exemptions
  - Are strategies that short sell different than other strategies?
- Are liquidity supply and demand separable?
  - Demand fall is larger, so its impacts dominate

How do we think about HFTs?

- Appears to be some component which is not helpful
  - How much of this is due to regulations (fragmentation)?

- What to do about it?
  - How do we identify (define) HFT?
    - If we regulate/disadvantage HFT, incentives to avoid
      - Old system of closest to the market given privileges/obligations
  - What is the exact problem?
    - Target behavior as opposed to labels
      - e.g., should we treat colocated firms differently? Is this possible?
      - Change the way that data is disseminated? Quasi-dark?
  - Is there a market solution?
    - Centralized trading? Slower? Randomization? Batch trading?
      - Is there some market/regulatory failure precluding this?