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JACOBS LEVY EQUITY MANAGEMENT CENTER
for Quantitative Financial Research

Circuit Breakers, Illiquidity, and the COVID-19 Crisis

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Circuit Breakers as Data-Driven Initiatives: The Flash Crash of May 6, 2010

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  - In effect outside of open and close during 2010-2011
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- 2nd solution: Limit Up Limit Down (LULD) “National Market System Plan to Address Extraordinary Market Volatility”
  - Implementation started in 2013
  - Different triggers for circuit breakers under LULD (activity in quoted prices) versus previous SSCBs (trades)

Motivation and Questions

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- Do circuit breakers interfere with trading activity?

- Existing literature (mostly covers non-US and/or earlier data): conflicting results regarding the benefits of circuit breakers

Contribution

- I identify the economic triggers for the recent LULD circuit breakers
- I link circuit breakers-related events in (some of) the S&P500 constituents to jumps in SPY
- I estimate the effect of circuit breakers on market quality (illiquidity and price discovery)
- I document their trading interference, which leads to market fragmentation during times of market stress
- This paper has immediate policy implications for the ongoing debate on the design of the U.S. market structure mechanism and the related regulation

Institutional Details: The LULD Design

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- Reference price: 5-min average of transaction prices (except for periods following openings and reopenings)
  - Gets updated with the pro-forma reference price every time it deviates at least 1% from it
- Pro-forma reference price: continuously updated during the day, as a 5-min arithmetic average of the previous trade prices
- Price bands differ for two groups of securities: Tier 1 (S&P 500, the Russell 1000, and some high volume ETPs) and Tier 2 (the remainder of stocks)

Institutional Details: Price Bands (%)

		Previous Closing Price	During Trading Day	During Open & Close (9:30-9:45 & 15:35-16:00)
Original Plan	Tier1	P >$3.00	5%	10%
		$0.75<=P<=$3.00	20%	40%
		P<$0.75	Min($0.15, 75%)	Min($0.30, 150%)
	Tier 2	P >$3.00	10%	20%
		$0.75<=P<=$3.00	20%	40%
		P<$0.75	Min ($0.15, 75%)	Min($0.30, 150%)

		Previous Closing Price	During Trading Day	During Close (15:35-16:00)
After 02/24/2020	Tier1	P >$3.00	5%	10%
		$0.75<=P<=$3.00	20%	40%
		P<$0.75	Min($0.15, 75%)	Min($0.30, 150%)
	Tier 2	P >$3.00	10%	10%
		$0.75<=P<=$3.00	20%	40%
		P<$0.75	Min ($0.15, 75%)	Min($0.30, 150%)

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- Trading Pause: triggered if limit state lasts 15 seconds
  - It lasts 5 minutes, and is followed by a reopening auction
  - Purpose: to facilitate fundamental price moves

"These limit up-limit down requirements would be coupled with trading pauses, as defined in Section I(X) of the Plan, to accommodate more fundamental price moves (as opposed to erroneous trades or momentary gaps in liquidity).“ (*SEC Release No. 34-67091, pg. 6)*

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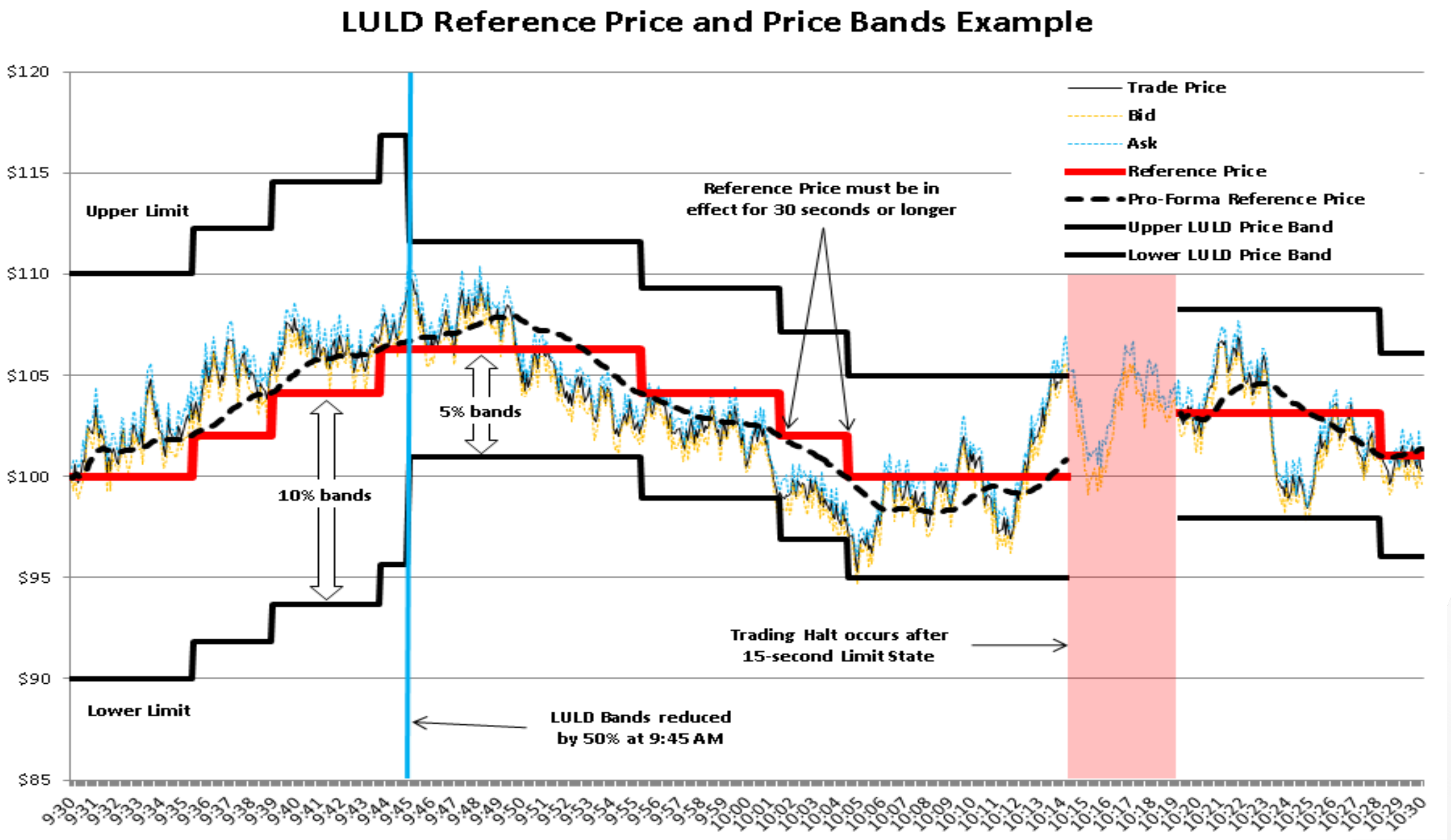
- Straddle State: one quote is outside the price bands and the stock is not in a Limit State
  - No limit on how long it can last

LULD Design: Simulation



Source: Moise and Flaherty (2017)

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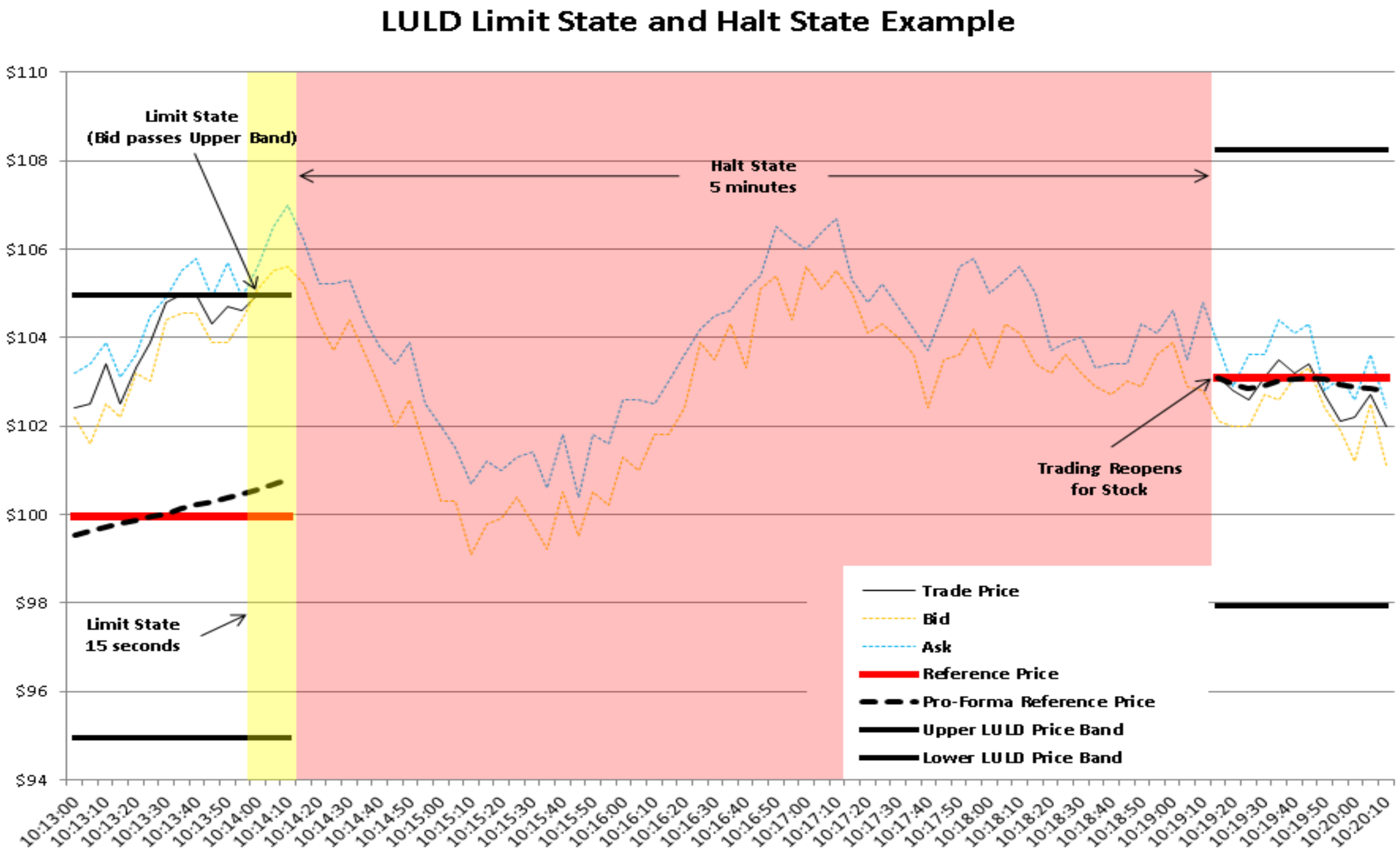

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(Big) Data

- Nanosecond timestamped data (Daily TAQ, Daily TAQ Quote LULD)
- Daily data (SEC's Market Information and Data Analytics System, MIDAS)
- Weekly data (FINRA ATS)

- I get straddle states, non-executable quotes, limit-up states, and limit-down states from Daily TAQ quotation data
- I identify halts based on Daily TAQ Quote LULD data
- I identify dark trading activity based on FINRA ATS and Daily TAQ data

- Sample period: January 1, 2020 - April 30, 2020

Tier Group Statistics

	Tier 1	Tier 2
Avg market cap ($ 1,000)	20,091	751
Avg trading volume (1000 shares)	4,093	575
Avg dollar volume ($ millions)	257	7
Avg closing spread (¢)	7	15
Avg trade price volatility (*10^5)	0.18	15
Avg quote volatility (*10^5)	0.01	3

Events by Type

		Jan 2020 – April 2020	
LULD Event		Tier 1	Tier 2
Straddle States	#Sec-Days	6,952	55,922
	%Days w/ event	100%	100%
Non-Exec	#Sec-Days	817	15,920
	%Days w/ event	87%	100%
Limit-Up	#Sec-Days	1,042	4,431
	%Days w/ event	58%	100%
Limit-Down	#Sec-Days	836	3,451
	%Days w/ event	48%	100%
#Trading Days		83	83
#Sec w/ Events		1,272	4,814

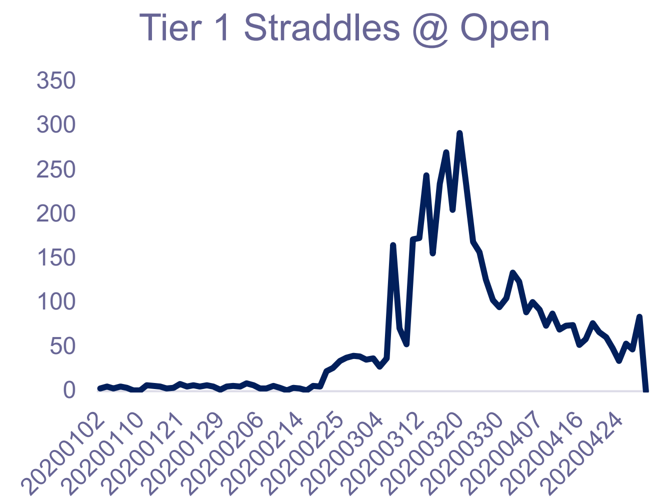
Events by Type

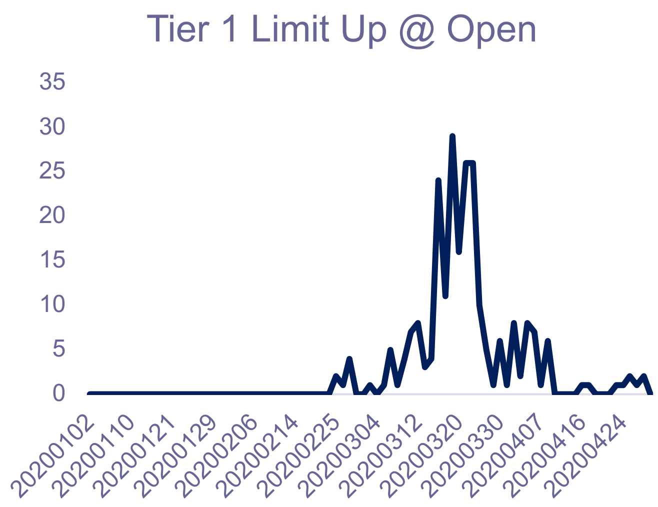
		Jan 2020 – April 2020		Sept 2019 – Dec 2019	
LULD Event		Tier 1	Tier 2	Tier 1	Tier 2
Straddle States	#Sec-Days	6,952	55,922	532	15,587
	%Days w/ event	100%	100%	100%	100%
Non-Exec	#Sec-Days	817	15,920	87	4,262
	%Days w/ event	87%	100%	69%	100%
Limit-Up	#Sec-Days	1,042	4,431	15	533
	%Days w/ event	58%	100%	15%	99%
Limit-Down	#Sec-Days	836	3,451	10	366
	%Days w/ event	48%	100%	11%	99%
#Trading Days		83	83	84	84
#Sec w/ Events		1,272	4,814	132	1,630

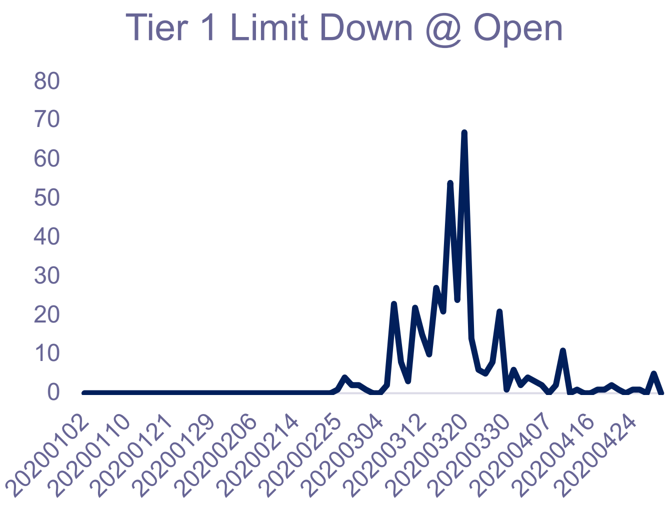
Events by Type and Time of Day based on Amendment 18 to the Plan

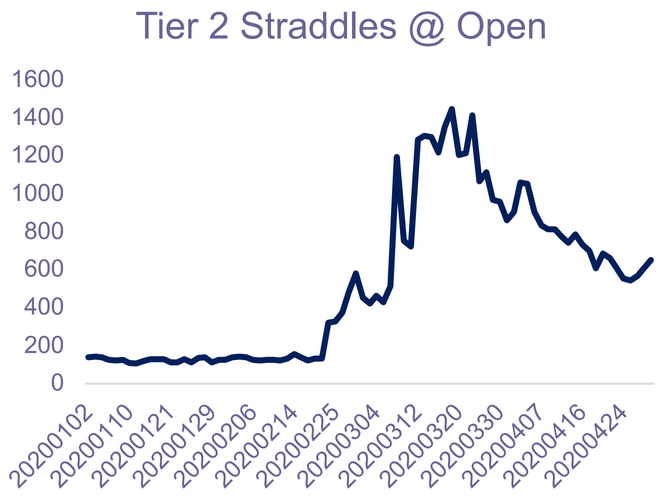
		Tier 1		Tier 2	
LULD Event		Bef Feb 24	Aft Feb 24	Bef Feb 24	Aft Feb 24
Straddle States	#Sec-Days @Open	157	4,869	4,494	39,391
	#Sec-Days Out of Open	51	2,962	3,979	26,434
Non-Exec	#Sec-Days @Open	35	560	1,418	11,753
	#Sec-Days Out of Open	3	284	538	5,349
Limit-Up	#Sec-Days @Open	0	237	29	1,101
	#Sec-Days Out of Open	5	840	235	3,314
Limit-Down	#Sec-Days @Open	0	384	7	1,005
	#Sec-Days Out of Open	2	525	144	2,525

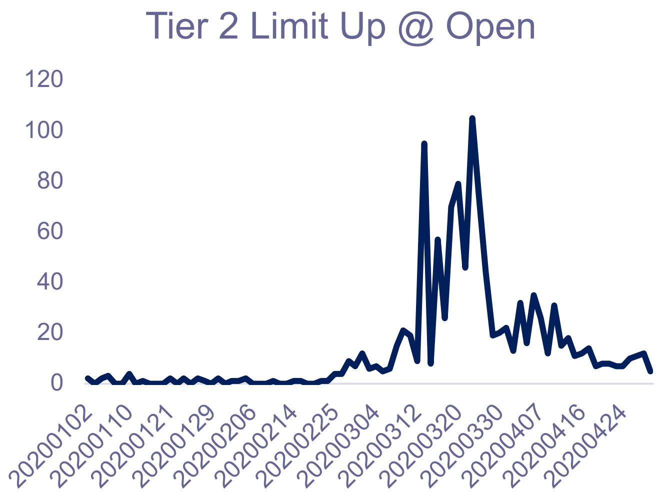
Daily Number of Securities with Events at the Open

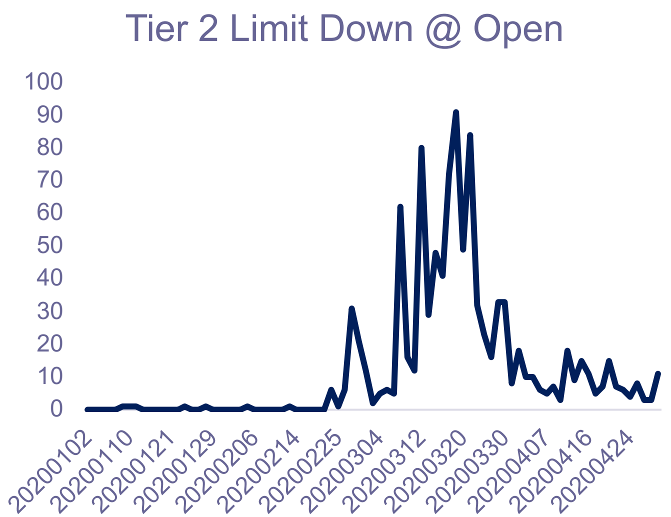












Trading Halts

- I exclude halts that occurred in the last 10 minutes of the trading day

- I also exclude halts that do not qualify as LULD pauses:
- Halts that are not preceded by limit or straddles states
- Halts that are triggered per SEC Rule 201
- Halts that are triggered by the Market Wide Circuit Breaker (MWCB)

Economic Triggers for Trading Halts

- After a trading halt, the price: a) can move in the direction it moved before the halt (in line with the Plan), or b) can revert back to its pre-suspension level

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- Under a), when trading resumes after the halt, I expect to see price continuation
  - Scenario consistent with an asymmetric-information hypothesis, where the arrival of fundamental information gets permanently incorporated into prices
  - The halt is a news event

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- After a trading halt, the price: a) can move in the direction it moved before the halt (in line with the Plan), or b) can revert back to its pre-suspension level
- Under a), when trading resumes after the halt, I expect to see price continuation
  - Scenario consistent with an asymmetric-information hypothesis, where the arrival of fundamental information gets permanently incorporated into prices
  - The halt is a news event
- Under b), when trading resumes after the halt, I expect to see price reversal
  - Scenario consistent with an inventory-control model, where dealers rebalance their positions during the halt
  - The halt is an illiquidity event

High-Frequency Price Formation

$$\underbrace{\tilde{p}_t}_{\text{Obs price}} = \underbrace{p_t}_{\text{Fundam value}} + \underbrace{\psi_t}_{\text{Deviation}}$$

$$dp_t = \phi_t dt + \sigma_t d\,W_t + k_t dq_t$$

- ϕ_t is a continuous predictable drift process
- Spot volatility σ_t is a càdlàg process; W is a standard BM
- q_t is a pure jump Lévy process with dq_t =1 if a jump occurs at time *t*, and 0 otherwise
- ψ_t has zero mean and a finite 4th moment

Extraordinary Volatility

- Divide each day of length *H* into *M* sub-periods ($\delta = \frac{H}{M}$ is the distance between obs.):

$$p_{j,t} = p_{0,t} + \int_{(t-1)+(j-1)\delta}^{(t-1)+j\delta} \phi_s ds + \int_{(t-1)+(j-1)\delta}^{(t-1)+j\delta} \sigma_s dW_s + \sum_{s \le t} \Delta k_s$$

- The *j*-th intraday return: $\tilde{r}_{j,t} = r_{j,t} + v_{j,t}$
- $r_{j,t}$ has a stochastic order of magnitude $O_p(\sqrt{\delta})$
- $v_{j,t}$ has a stochastic order of magnitude $O_p(1)$

$$Var(\tilde{r}_{j,t}) = Var(r_{j,t} + v_{j,t})$$

→ $Var(r_{j,t})$

→ $Var(v_{j,t})$

Identifying the Economic Trigger for the Halts

$$\underbrace{\tilde{p}_t}_{\text{Obs price}} = \underbrace{p_t}_{\text{Fundam value}} + \underbrace{\psi_t}_{\text{Deviation}}$$

$$dp_t = \phi_t dt + \sigma_t d\, W_t + k_t dq_t$$

- I consider two time windows, t_1 (before the halt) and t_2 (after the halt)
- I analyze the price trends in t_1 and t_2

Price Behavior after Trading Halts

All Securities		
	Tier 1	Tier 2
Price Reversal in Sec-Days	76%	79%
Price Continuation in Sec-Days	24%	21%
N	311	2,539

- Trading halts occur not only to accommodate fundamental price moves (as designed), but are also (and mostly) triggered by liquidity gaps

Price Behavior after Trading Halts

All Securities	Tier 1	Tier 2
Price Reversal in Sec-Days	76%	79%
Price Continuation in Sec-Days	24%	21%
N	311	2,539

Only S&P500 Constituents	
Price Reversal in Sec-Days	85%
Price Continuation in Sec-Days	15%
N	55

- Trading halts occur not only to accommodate fundamental price moves (as designed), but are also (and mostly) triggered by liquidity gaps

Relation between LULD Events and SPY Jumps

- Why is jump risk important?
  - Compared to continuous price changes, jumps have different implications for risk management, portfolio allocation, and the valuation of derivative securities

Relation between LULD Events and SPY Jumps

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  - Compared to continuous price changes, jumps have different implications for risk management, portfolio allocation, and the valuation of derivative securities

- When constituents of the S&P500 halt, SPY continues to trade
  - When trading in the S&P500 constituents resumes, jumps may be recorded in the SPY price
  - The high-frequency arbitrage mechanism may get disrupted when S&P500 constituents halt (ex: the Mini Flash Crash of August 24, 2015)
  - Halts may lead to a dislocation between SPY and the underlying portfolio

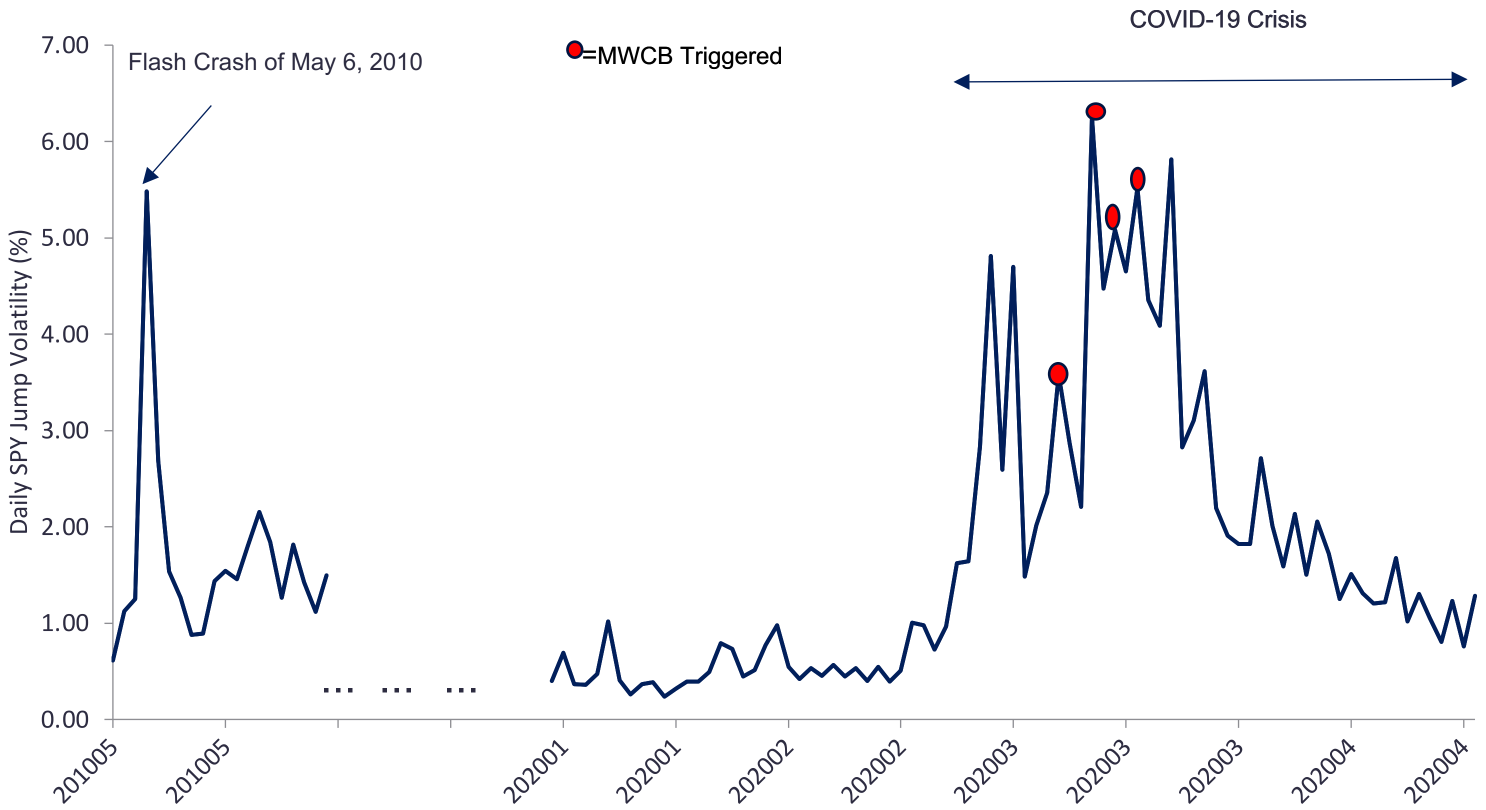
Jump Estimation

- Quadratic variation: $QV_{t,t+H} = \int_t^{t+H} \sigma_s^2 ds + \sum_s k_s^2$
- Realized fundamental variation: $RV_{t,t+H} = \sum_{j=1}^{M} \tilde{r}_{tj}^2 \xrightarrow[M\to\infty]{p} QV_{t,t+H}$
- *M* = # of 5-min sampling intervals in a trading day of length *H*
- Bipower variation: $BPV_{t,t+H} = \mu^{-1} \sum_{j=k+1}^{M} |\tilde{r}_{t,j}^M||\tilde{r}_{t,j-k}^M| \xrightarrow[M\to\infty]{p} \int_t^{t+H} \sigma_s^2 ds$

$$\mu^p = 2^{\frac{p}{2}}\Gamma\left(\frac{p+1}{2}\right)/\sqrt{\pi}$$

- Jump volatility for day *t*: $JV_t = \sqrt{RV_t - BPV_t} = \sqrt{\sum_{j=1}^{M} \tilde{r}_{t,j}^2 - \mu^{-1} \sum_{j=k+1}^{M} |\tilde{r}_{t,j}^M||\tilde{r}_{t,j-k}^M|}$

Daily SPY Jump Volatility



Regression of Daily SPY Jump Volatility on LULD Events in the Constituents of S&P500

	(i)	(ii)
Intercept	1.38***	-0.31*
(adj p-value)	*(0.0001)*	*(0.0844)*
#Halts	0.53***	0.16**
(adj p-value)	*(0.0001)*	*(0.0152)*
VIX		0.06***
(adj p-value)		*(0.0003)*
$AdjR^2$ (%)	35.28	74.08

(Benjamini and Hochberg (1995) multiplicity-adjusted p-values in parentheses)

Regression of Daily SPY Jump Volatility on LULD Events in the Constituents of S&P500

	(i)	(ii)	(iii)	(iv)
Intercept	1.38***	-0.31*	1.36***	-0.31*
(adj p-value)	*(0.0001)*	*(0.0844)*	*(0.0001)*	*(0.0839)*
#Halts	0.53***	0.16**		
(adj p-value)	*(0.0001)*	*(0.0152)*		
#Illiq_Halts			0.48***	0.14**
(adj p-value)			*(0.0001)*	*(0.0153)*
VIX		0.06***		0.06***
(adj p-value)		*(0.0003)*		*(0.0003)*
$AdjR^2$ (%)	35.28	74.08	35.92	74.66

Regression of Daily SPY Jump Volatility on LULD Events in the Constituents of S&P500

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Intercept	1.38***	-0.31*	1.36***	-0.31*	1.04***	-0.25
(adj p-value)	*(0.0001)*	*(0.0844)*	*(0.0001)*	*(0.0839)*	*(0.0001)*	*(0.1790)*
#Halts	0.53***	0.16**				
(adj p-value)	*(0.0001)*	*(0.0152)*				
#Illiq_Halts			0.48***	0.14**		
(adj p-value)			*(0.0001)*	*(0.0153)*		
#Events					86.39***	26.81**
(adj p-value)					*(0.0001)*	*(0.0114)*
VIX		0.06***		0.06***		0.05***
(adj p-value)		*(0.0003)*		*(0.0003)*		*(0.0003)*
$AdjR^2$ (%)	35.28	74.08	35.92	74.66	52.89	74.25

Effect of Circuit Breakers on Market Quality

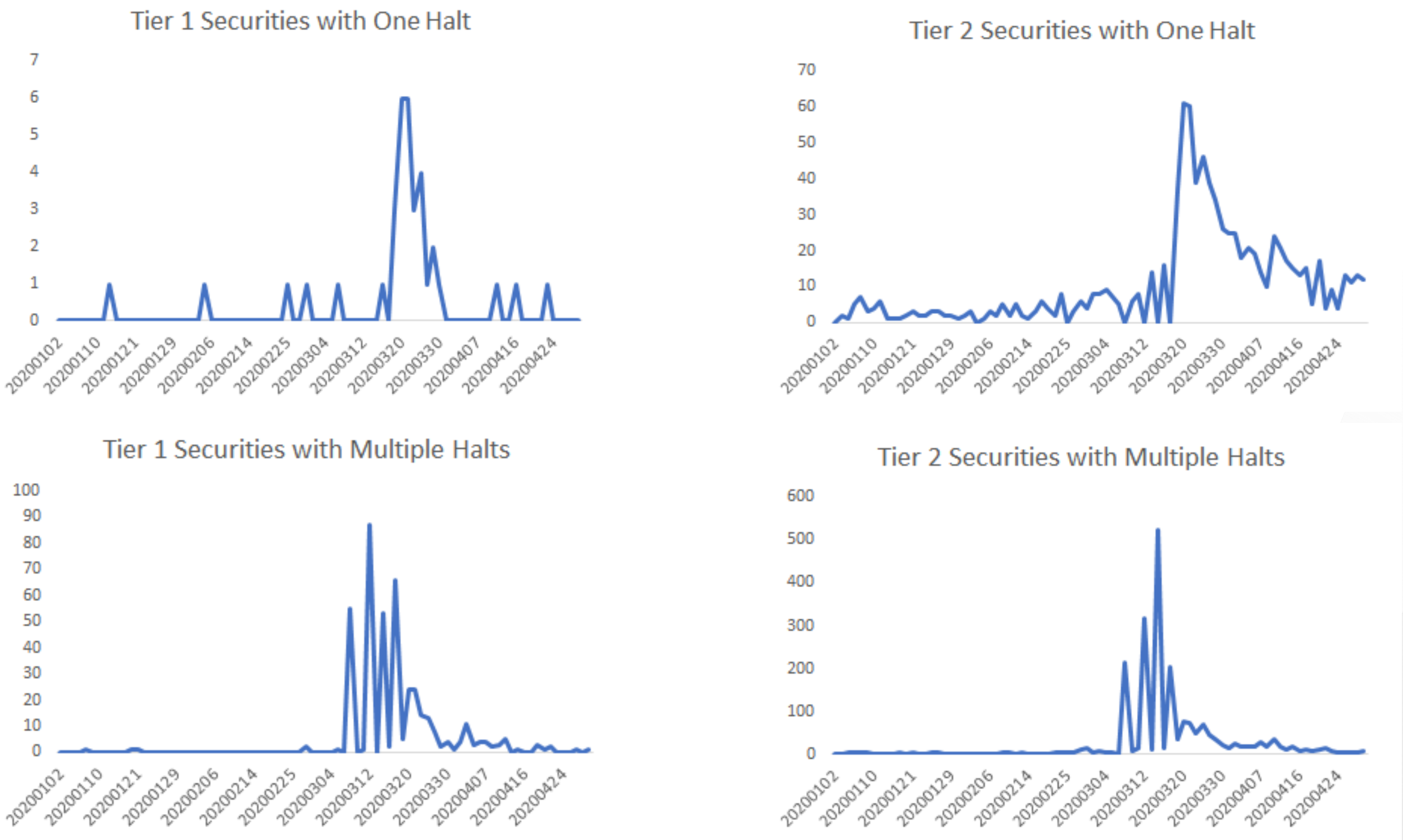
- Methodology: Regression Discontinuity Design (RDD)
- Threshold event: a security enters a limit or a straddle state
- Treatment: a security enters a trading halt

$$y_i = \beta + \alpha T_i + (X_i \gamma)' + \varepsilon_i$$

- y_i = day *i* market quality metric (illiquidity or price efficiency)
  - y_i is a daily cross-sectional average

- α = the treatment effect
- T_i = 1 if a halt follows a limit or straddle state; T_i = 0 otherwise
- X_i = Controls: AvgQVolat and AvgLogVol

Daily Number of Securities with Trading Halts



Illiquidity Proxies: Simple Averaged Effective Spread

$$ESpr_k = 2D_k(P_k - M_k) / M_k \quad \text{for trade } k$$

- $D_k = +1$, if trade k is a buy, and $D_k = -1$, if trade k is a sell
- P_k = price, M_k = midquote; trade is a buy if $P>M$ and a sell if $P<M$

$$AvgESpr_{j,i} = \frac{1}{N_{j,i}} \sum_{k=1}^{N_{j,i}} ESpr_k$$ for stock j on day i; $N_{j,i}$=total # of trades

- The metric of interest is the XS average for day i:

$$y_i = AvgESpr_i = \frac{1}{N_i} \sum_{j=1}^{N_i} AvgESpr_{j,i}$$

- N_i=total # of stocks that entered a limit or a straddle state on day i

- Note: $ESpr_k = PI_k + RSpr_k$

Illiquidity Proxies: Simple Averaged Price Impact

$PI_k = 2D_k(M_{k+5} - M_k) / M_k$ for trade k

- M_{k+5} = midpoint 5 min after the trade

$$AvgPI_{j,i} = \frac{1}{N_{j,i}} \sum_{k=1}^{N_{j,i}} PI_k$$ for stock j on day i; $N_{j,i}$=total # of trades

- The metric of interest is the XS average for day *i*:

$$y_i = AvgPI_i = \frac{1}{N_i} \sum_{j=1}^{N_i} AvgPI_{j,i}$$

- N_i=total # of stocks that entered a limit or a straddle state on day *i*

Illiquidity Proxies: Simple Averaged Realized Spread

$$RSpr_k = 2D_k(P_k - M_{k+5})\,/M_k \;\; for\ trade\ k$$

- M_{k+5} = midpoint 5 min after the trade

$$AvgRSpr_{j,i} = \frac{1}{N_{j,i}}\sum_{k=1}^{N_{j,i}} RSpr_k$$ for stock *j* on day *i*; $N_{j,i}$=total # of trades

- The metric of interest is the XS average for day *i*:

$$y_i = AvgRSpr_i = \frac{1}{N_i}\sum_{j=1}^{N_i} AvgRSpr_{j,i}$$

- N_i=total # of stocks that entered a limit or a straddle state on day *i*

Circuit Breakers' Effects on Illiquidity

	Tier 1		
	AvgESpr	AvgPI	AvgRSpr
Halt	0.36***	0.11	0.16**
(adj p-value)	*(0.0001)*	*(0.3022)*	*(0.0324)*
AvgQVolat	89.38***	153.08***	-47.16***
(adj p-value)	*(0.0001)*	*(0.0004)*	*(0.0002)*
AvgLogVol	-0.11***	-0.00	-0.17***
(adj p-value)	*(0.0001)*	*(0.9085)*	*(0.0007)*
N	119	119	119

Circuit Breakers' Effects on Illiquidity

	Tier 1			Tier 2		
	AvgESpr	AvgPI	AvgRSpr	AvgESpr	AvgPI	AvgRSpr
Halt	0.36***	0.11	0.16**	2.26***	1.26***	0.95***
(adj p-value)	*(0.0001)*	*(0.3022)*	*(0.0324)*	*(0.0001)*	*(0.0001)*	*(0.0004)*
AvgQVolat	89.38***	153.08***	-47.16***	-5.82	-2.30	-3.47
(adj p-value)	*(0.0001)*	*(0.0004)*	*(0.0002)*	*(0.1713)*	*(0.5251)*	*(0.4566)*
AvgLogVol	-0.11***	-0.00	-0.17***	-0.48***	-0.35***	-0.11
(adj p-value)	*(0.0001)*	*(0.9085)*	*(0.0007)*	*(0.0001)*	*(0.0001)*	*(0.4363)*
N	119	119	119	162	162	162

Price Efficiency Proxies: Variance Ratios

- $VR_{5,j,i} = \left|\frac{Var_{5min}}{5 * Var_{1min}} - 1\right|$ for stock *j* on day *i*
- $VR_{15,j,i} = \left|\frac{Var_{15min}}{3 * Var_{5min}} - 1\right|$ for stock *j* on day *i*
- $VR_{30,j,i} = \left|\frac{Var_{30min}}{2 * Var_{15min}} - 1\right|$ for stock *j* on day *i*

- The metrics of interest are the XS averages for day *i* (N_i=total # of stocks that entered a limit or a straddle state on day *i*)
- $y_i = AvgVR_{5,i} = \frac{1}{N_i}\sum_{j=1}^{N_i} VR_{5,j,i}$
- $y_i = AvgVR_{15,i} = \frac{1}{N_i}\sum_{j=1}^{N_i} VR_{15,j,i}$
- $y_i = AvgVR_{30,i} = \frac{1}{N_i}\sum_{j=1}^{N_i} VR_{30,j,i}$

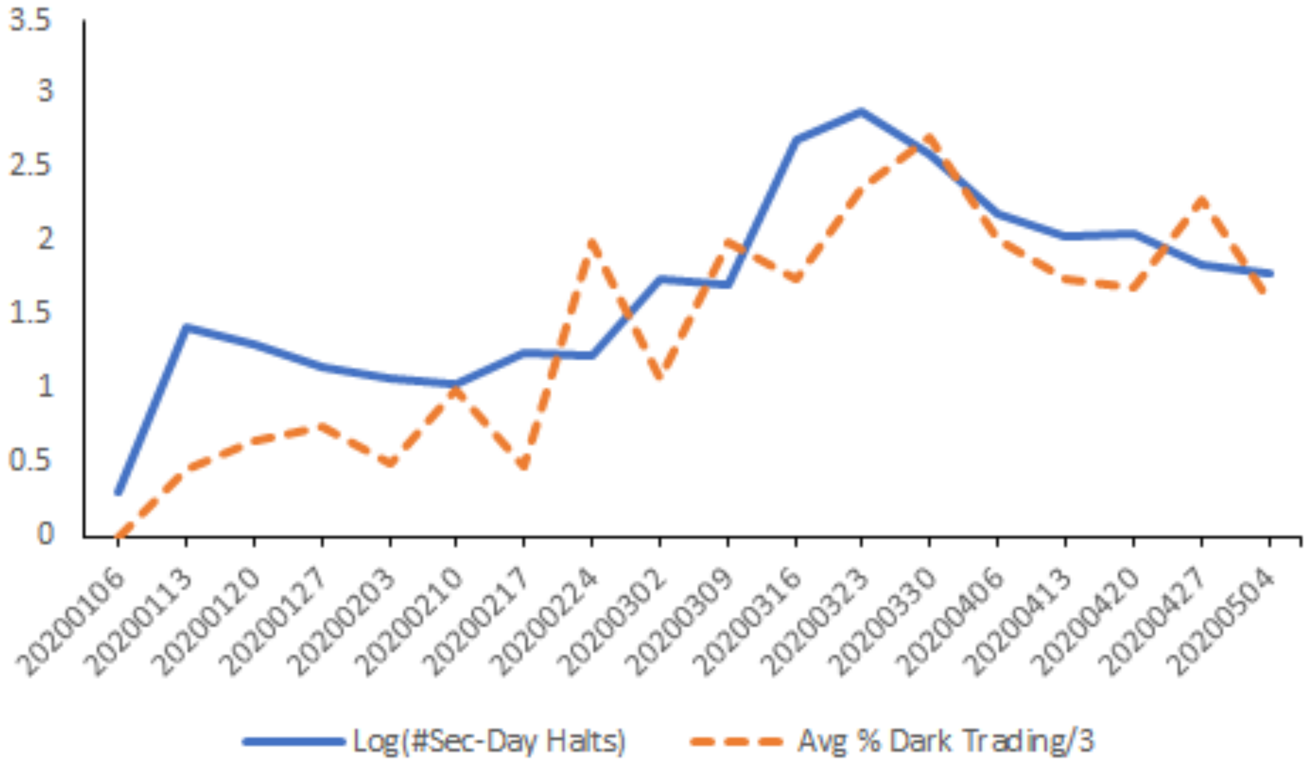
Circuit Breakers' Effects on Price Discovery

	Tier 1		
	$AvgVR_{5}$	$AvgVR_{15}$	$AvgVR_{30}$
Halt	-0.01	0.05	-0.00
(adj p-value)	*(0.6858)*	*(0.1513)*	*(0.9649)*
AvgQVolat	9.42***	8.84**	-2.00
(adj p-value)	*(0.0002)*	*(0.0116)*	*(0.6707)*
AvgLogVol	-0.01	-0.00	0.01
(adj p-value)	*(0.2577)*	*(0.7523)*	*(0.3846)*
N	119	119	119

Circuit Breakers' Effects on Price Discovery

	Tier 1			Tier 2		
	$AvgVR_5$	$AvgVR_{15}$	$AvgVR_{30}$	$AvgVR_5$	$AvgVR_{15}$	$AvgVR_{30}$
Halt	-0.01	0.05	-0.00	0.07***	0.08***	0.06***
(adj p-value)	*(0.6858)*	*(0.1513)*	*(0.9649)*	*(0.0001)*	*(0.0002)*	*(0.0002)*
AvgQVolat	9.42***	8.84**	-2.00	-0.77***	-0.60**	-1.24***
(adj p-value)	*(0.0002)*	*(0.0116)*	*(0.6707)*	*(0.0007)*	*(0.0157)*	*(0.0002)*
AvgLogVol	-0.01	-0.00	0.01	-0.05***	-0.02***	0.02***
(adj p-value)	*(0.2577)*	*(0.7523)*	*(0.3846)*	*(0.0001)*	*(0.0012)*	*(0.0069)*
N	119	119	119	162	162	162

Halts and Dark Trading Activity (Based on FINRA Data)



Trading Activity (Based on TAQ Data)

- Dark-to-Trade Ratio for stock *j* during day *i:*

$$Drk\_Trd_{j,i} = \frac{Drk\_trd}{(Drk_{trd} + NonDrk\_trd)}$$

Drk_Trd= # of trades executed on dark pools

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Drk_Trd= # of trades executed on dark pools

- Intermarket Sweep Orders (ISOs) for stock *j* during day *i:*

$$ISO\_Trd_{j,i} = \frac{ISO\_trd}{(ISO\_trd + NonISO\_trd)}$$

ISO_Trd= # of ISO trades

- Use the above RDD methodology for the two trading strategies
- Metric of interest is the day *i* XS average: $y_i = AvgDrk\_Trd$ and $y_i = AvgISO\_Trd$
- Additional control: *Avg|Ord_Imb|* = *|Buys-Sells|/(Buys +Sells)*

Circuit Breakers' Effects on Trading Activity

	AvgDrk_Trd	
	Tier 1	Tier 2
Halt	4.30*	-0.71
(adj p-value)	*(0.0580)*	*(0.4736)*
AvgQVolat	-2.76	-0.78***
(adj p-value)	*(0.2389)*	*(0.0020)*
AvgLogVol	1.38*	2.93***
(adj p-value)	*(0.0543)*	*(0.0010)*
Avg|Ord_Imb|	42.39*	8.99
(adj p-value)	*(0.0543)*	*(0.4736)*
N	119	162

Circuit Breakers' Effects on Trading Activity

	AvgDrk_Trd		AvgISO_Trd	
	Tier 1	Tier 2	Tier 1	Tier 2
Halt	4.30*	-0.71	-3.12**	2.07**
(adj p-value)	*(0.0580)*	*(0.4736)*	*(0.0148)*	*(0.0213)*
AvgQVolat	-2.76	-0.78***	5.27***	-0.28
(adj p-value)	*(0.2389)*	*(0.0020)*	*(0.0008)*	*(0.1962)*
AvgLogVol	1.38*	2.93***	1.47***	-0.42
(adj p-value)	*(0.0543)*	*(0.0010)*	*(0.0005)*	*(0.4764)*
Avg|Ord_Imb|	42.39*	8.99	10.91	-11.51
(adj p-value)	*(0.0543)*	*(0.4736)*	*(0.3209)*	*(0.2054)*
N	119	162	119	162

Robustness Checks ("Treated": Only Securities with Illiquid Halts)

	Tier 1			Tier 2		
	AvgESpr	AvgPI	AvgRSpr	AvgESpr	AvgPI	AvgRSpr
Halt	0.27***	0.13	0.13**	2.54***	0.91***	1.67***
(adj p-value)	*(0.0001)*	*(0.3022)*	*(0.0324)*	*(0.0001)*	*(0.0004)*	*(0.0001)*

N for Tier1	112
N for Tier2	160

Robustness Checks ("Treated": Only Securities with Illiquid Halts)

	Tier 1			Tier 2		
	AvgESpr	AvgPI	AvgRSpr	AvgESpr	AvgPI	AvgRSpr
Halt	0.27***	0.13	0.13**	2.54***	0.91***	1.67***
(adj p-value)	*(0.0001)*	*(0.3022)*	*(0.0324)*	*(0.0001)*	*(0.0004)*	*(0.0001)*

	Tier 1			Tier 2		
	AvgVR5	AvgVR15	AvgVR30	AvgVR5	AvgVR15	AvgVR30
Halt	0.02	0.10***	0.02	0.07***	0.09***	0.05***
(adj p-value)	*(0.3045)*	*(0.0008)*	*(0.4829)*	*(0.0001)*	*(0.0001)*	*(0.0055)*

N for Tier1	112
N for Tier2	160

Robustness Checks (“Treated”: Only Securities with Illiquid Halts)

	Tier 1			Tier 2		
	AvgESpr	AvgPI	AvgRSpr	AvgESpr	AvgPI	AvgRSpr
Halt	0.27***	0.13	0.13**	2.54***	0.91***	1.67***
(adj p-value)	*(0.0001)*	*(0.3022)*	*(0.0324)*	*(0.0001)*	*(0.0004)*	*(0.0001)*

	Tier 1			Tier 2		
	AvgVR5	AvgVR15	AvgVR30	AvgVR5	AvgVR15	AvgVR30
Halt	0.02	0.10***	0.02	0.07***	0.09***	0.05***
(adj p-value)	*(0.3045)*	*(0.0008)*	*(0.4829)*	*(0.0001)*	*(0.0001)*	*(0.0055)*

	AvgDrk_Trd		AvgISO_Trd	
	Tier 1	Tier 2	Tier 1	Tier 2
Halt	6.52**	-0.68	-2.65**	2.31**
(adj p-value)	*(0.0193)*	*(0.7960)*	*(0.0542)*	*(0.0226)*

N for Tier1	112
N for Tier2	160

Conclusions

- Circuit breakers have prevented market crashes from occurring during the pandemic
- While designed to accommodate news shocks, most of the trading halts turn out to be illiquidity events
- Illiquidity-driven halts in (some of) the S&P500 constituents are associated with jumps in SPY
- Halts are followed by subsequent lower liquidity in all securities, and by worse price discovery in smaller securities
- Channels for liquidity depletion: increased dark trading in large stocks, and increased use of ISO-designated orders in small stocks, which indicates market fragmentation

Recommendations

- Redesign the price bands parameters based on securities' volatilities
- Design a longer duration limit state for Tier 2 securities to avoid halts
- Revisit the recent removal of double price bands at the open
- Regulators need to keep a close watch on the levels of dark trading and on ISO usage during times of market stress
- There is need for a better coordination between the spot and the derivatives markets