Do regulatory hurdles on algorithmic trading work?

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Background

- Advances in technology have altered the microstructure of the markets.
- Algorithmic trading (AT, or its close kin, HFT) dominates trading activity worldwide.
- Benefits indisputable, but concerns regarding the negative externalities imposed by these traders.
- AT/HFT has been a subject of intense focus amongst the regulators. Pressure on the regulators to 'do something'.
- Consequence: Several policy proposals being contemplated to curb AT/HFT activity (MiFID II, HFT Act etc).

The question

- A regulatory intervention is justified if
  1. there is an identified market failure.
  2. the proposed intervention addresses the market failure appropriately.
  3. the costs are outweighed by the gains to the society from the intervention.

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- **The intervention**: Charge fees/penalise traders with high orders to trades (OTR) ratio.

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- **This paper**: examines the effect of one such intervention in the context of Indian equity markets.
- **The intervention**: Charge fees/penalise traders with high orders to trades (OTR) ratio.
- **The question**:
  1. Did the intervention address the market failure?
  2. Were there some unintended consequences of the intervention?

OTR fee: The rationale

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- **The solution prescribed**: Impose a fee if the OTR crosses a certain threshold.
- **Expected outcome**: Costs of high OTR internalised by those who generate it, resulting in lower OTR.
- **Unexpected outcome**: If not designed appropriately, has potential to adversely affect market quality, liquidity provisioning.

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- **Our focus**: Analyse the intervention in terms of these two outcomes – was the expected effect realised? were there unexpected consequences?

Advantages in this paper

OTR fee at NSE: An interesting case study

- Internationally, exchanges including the NASDAQ, NYSE Euronext, OSE, Borsa Italiana, TSX have implemented the fee.
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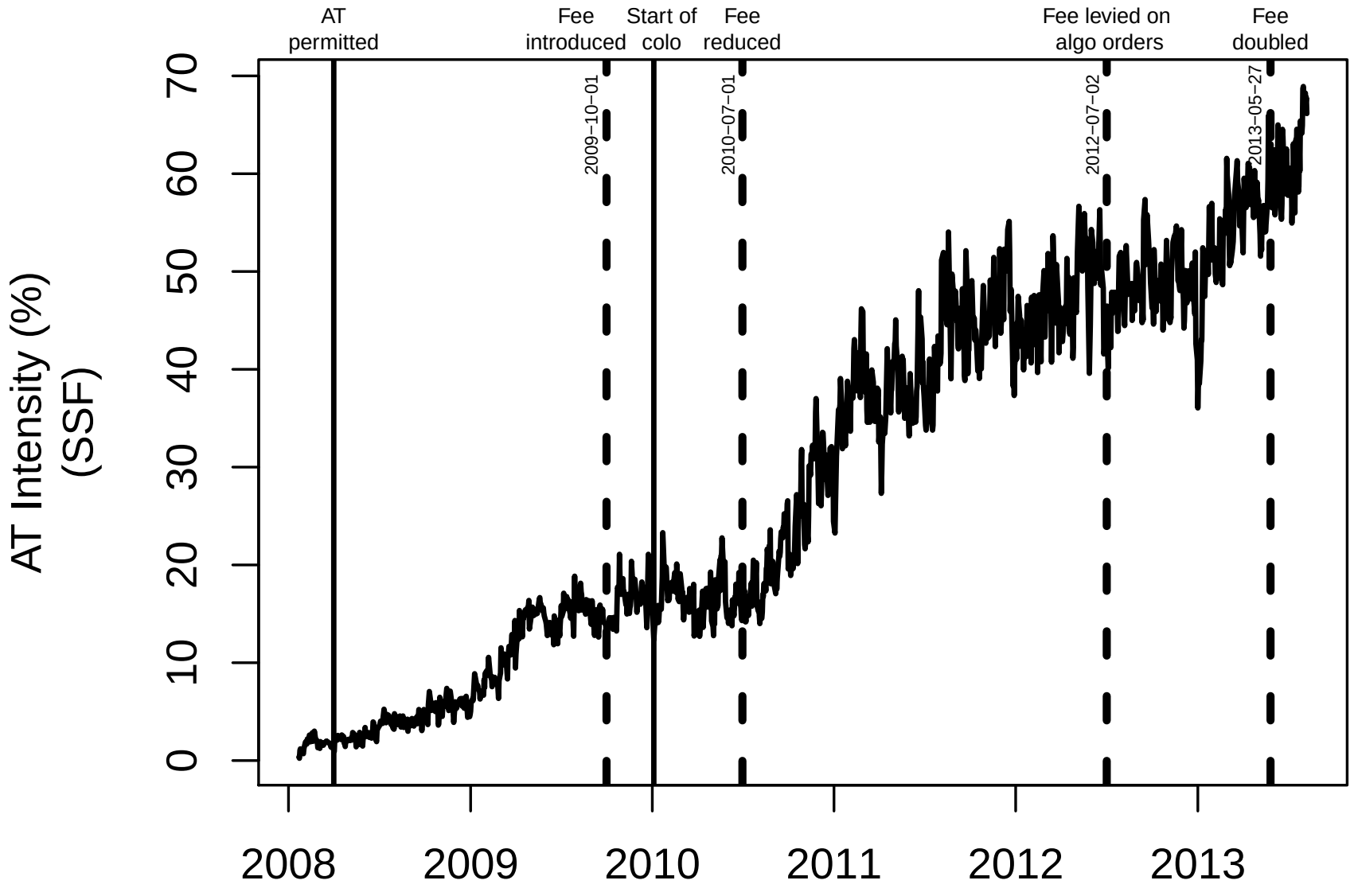
- At NSE,
  1. the fee implementation in 2009 was an **exchange** initiative (to reduce load on its infrastructure).
  2. the fee hike in 2012 was due to **regulatory** initiative.

Timeline of the events at the NSE



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- **Offers** a neat research design to evaluate the impact of the fee by using cash market as a control.
- **We focus on the 1st and the last event:**
  1. **Event 1**: Fee implementation by the exchange in 2009.
  2. **Event 2**: Fee doubled by the regulator in 2013.

What we find

- **Impact of Event 1**:
  1. A significant **reduction** in the average OTR after the event, indicating that the exchange managed to achieve what it intended.
  2. However, this impact was accompanied by a significant **deterioration** in the market quality variables – an unintended consequence.

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- **Impact of Event 2**:
  1. The event, did not see any shift. Neither in the trading behavior of the participants by way of OTR, nor in the market quality variables.
  2. Indicates the insignificance of the event.

Research setting

Data details

- **Period of the study**:
  1. Event 1: Introduction of OTR fee on 01 Oct 2009.
     a) Pre event: Jun - Aug 2009
     b) Post event: Oct - Dec 2009
  2. Event 2: Doubling of OTR fee on 27 May 2013.
     a) Pre event: Mar - May 2013
     b) Post event: Jun - Jul 2013
- **Sample**: Nifty stocks in the period between 2009 and 2013.
- **Segment analysed**: Near month single stock futures.
- **Data used**: Tick by tick orders and trades data, with flags identifying if an order or a trade is AT or non AT, and trader category. Flag on type of order event: entry, modification or cancellation.

Some facts

Features of trading on the NSE single stock futures market

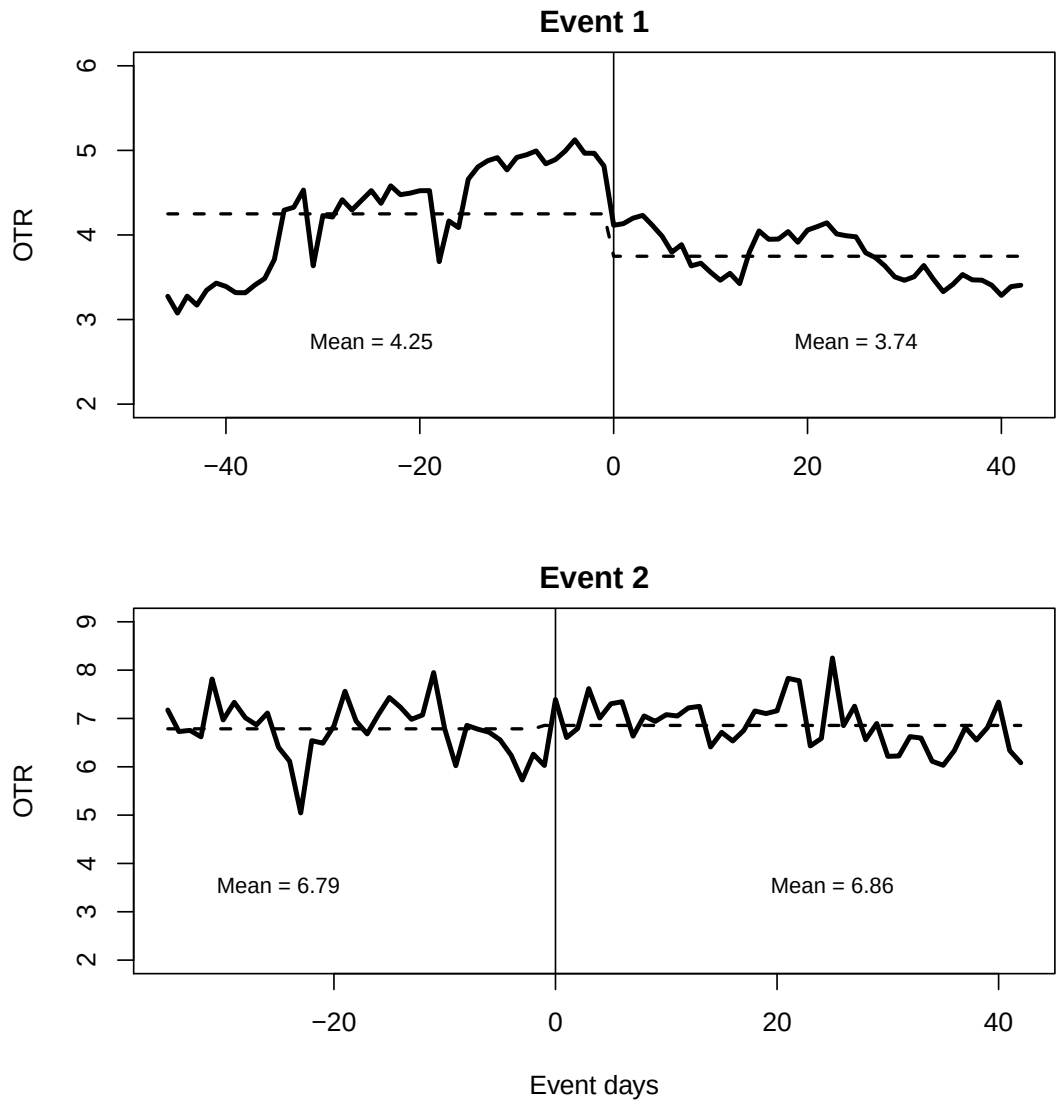
	Event 1		Event 2	
	Pre	Post	Pre	Post
AT-Intensity (%)	18.25	20.34	64.63	67.62
# of orders events	543,557	277,680	1,532,399	1,805,484
Sources of orders events			(as % of order events)	
Algo	50.91	53.89	97.56	97.64
Algo prop	46.37	45.56	83.96	82.5
Non algo	49.09	46.11	2.44	2.36
Orders modified				
Algo	35.67	36.8	80.24	80.25
Algo prop	32.44	30.91	71.45	70.33
Non algo	16.51	22.5	0.78	0.97
Orders cancelled				
Algo	7.45	8.27	8.44	8.50
Algo prop	6.81	7.11	6.12	5.97
Non algo	14.75	9.58	0.49	0.47
Orders executions				
Algo	0.40	0.65	0.50	0.43
Algo prop	0.37	0.50	0.29	0.25
Non algo	3.69	5.23	0.77	0.55

Measurement

OTR measurement

- At an order level, compute
  1. OTR = Number of orders events / (1 + Number of trades)
  2. OTR intensity = OTR/(Average time between modifications)
- For each stock, we compute value weighted average OTR for the day.
- For the day, we compute market cap weighted OTR across all stocks.

OTR graph pre and post the event



Market quality measures

- **Liquidity**
  1. Transactions costs
     - 1.1 QSPREAD (in %): (best ask - best sell)$\times$ 100 / mid-quote price.
     - 1.2 Price impact (PRICE IMPACT, %): execution cost of a market order at a size of Rs 250,00 relative to the mid-quote price.
  2. Depth
     - 2.1 TOP1DEPTH (in Rs.): Rupee depth available at the best bid and ask prices.
     - 2.2 TOP5DEPTH (in Rs.): Cumulated Rupee depth available at top five best bid and ask prices.
     - 2.3 DEPTH (# of shares): Average of the outstanding buy side and sell side number of shares.
  3. Amihud's illiquidity measure, ILLIQ: Ratio of daily absolute stock return to traded value.

Market quality measures (contd..)

- **Efficiency**
  1. VR: Ratio of ten-minutes variance of returns to two times the variance of five-minutes returns in a day.
  2. BASIS (%): Difference in the actual and implied futures price, relative to the spot price.
- **Volatility**
  1. Price risk, RVOL: Standard deviation of five-minutes returns.
  2. Liquidity risk, LRISK: Standard deviation of PRICE IMPACT.
  3. Basis risk, (σ_{BASIS}): Standard deviation of the basis.

Methodology

Impact evaluation: The approach

- **On OTR and OTR intensity**:
  1. Estimate a fixed effects panel regression specified as:

$$\begin{aligned}\text{VWTD-OTR}_{i,t} = \; & \alpha_i + \beta_1 \times \text{FEEDUMMY}_t + \beta_2 \times \text{AT-INTENSITY}_{i,t} + \\ & \beta_3 \times \text{MCAP}_{i,t} + \beta_4 \times \text{INVERSE-PRICE}_{i,t} + \\ & \beta_5 \times \text{NIFTY-VOL}_t + \epsilon_{i,t}\end{aligned}$$

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  2. Hypothesis: If the event had an impact on OTR, $\beta_1 < 0$.
- **On market quality**:
  1. The fee only implemented on derivatives, not on cash.
  2. Use cash market as a control to evaluate the impact using a DID regression:

$$\begin{aligned}\text{MKT-QUALITY}_{i,t} &= \alpha + \beta_1 \times \text{TREATED}_i + \beta_2 \times \text{FEEDUMMY}_t + \\ &\quad \beta_3 \times \text{TREATED}_i \times \text{FEEDUMMY}_t + \beta_4 \times \text{AT-INTENSIT} \\ &\quad \beta_5 \times \text{MCAP}_{i,t} + \beta_6 \times \text{INVERSE-PRICE}_{i,t} + \\ &\quad \beta_7 \times \text{NIFTY-VOL}_t + \epsilon_{i,t}\end{aligned}$$

  3. Hytpothesis: If the event did not have any impact on market quality, $\beta_3 = 0$.

Results

Impact on OTR: Panel regression

$$\text{VWTD-OTR}_{i,t} = \alpha_i + \beta_1 \times \text{FEEDUMMY}_t + \beta_2 \times \text{AT-INTENSITY}_{i,t} + \beta_3 \times \text{MCAP}_{i,t} + \beta_4 \times \text{INVERSE-PRICE}_{i,t} + \beta_5 \times \text{NIFTY-VOL}_t + \epsilon_{i,t}$$

	Event 1			Event 2		
	$\hat{\beta}_1$	t-stat	R^2	$\hat{\beta}_1$	t-stat	R^2
OTR	**-0.65**	-4.60	0.11	0.11	0.71	0.01
OTR-INTENSITY	**-0.39**	-5.29	0.11	**48.35**	5.00	0.06

Significant impact on OTR and OTR intensity post event 1, but no such impact post event 2.

Impact on market quality: DID regression

$$\begin{aligned}\text{MKT-QUALITY}_{i,t} = {} & \alpha + \beta_1 \times \text{TREATED}_i + \beta_2 \times \text{FEEDUMMY}_t + \\ & \beta_3 \times \text{TREATED}_i \times \text{FEEDUMMY}_t + \beta_4 \times \text{AT-INTENSITY}_{i,t} + \\ & \beta_5 \times \text{MCAP}_{i,t} + \beta_6 \times \text{INVERSE-PRICE}_{i,t} + \\ & \beta_7 \times \text{NIFTY-VOL}_t + \epsilon_{i,t}\end{aligned}$$

	Event 1			Event 2		
Mkt-Quality	$\hat{\beta}_3$	t-stat	R^2	$\hat{\beta}_3$	t-stat	R^2
QSPREAD	**0.06**	7.82	0.24	0.00	0.04	0.57
PRICE IMPACT	**0.07**	8.21	0.18	-0.00	-1.34	0.37
TOP1DEPTH	0.01	0.24	0.58	0.02	0.65	0.82
TOP5DEPTH	**-0.09**	-1.99	0.53	-0.03	-1.02	0.75
DEPTH	**-0.91**	-10.73	0.66	0.01	0.14	0.59
ILLIQ	-1.10	-1.46	0.15	-0.14	-0.54	0.11
|VR-1|	-0.00	-0.04	0.01	**-0.01**	-2.45	0.01
RVOL	-0.61	-0.49	0.29	-0.18	-0.28	0.23
LIQRISK	**0.08**	11.98	0.24	0.00	0.68	0.14

Impact on informational efficiency: basis and basis risk

$$\begin{aligned}\text{BASIS}_{i,t} \quad = \quad & \alpha_i + \beta_1 \times \text{VWTD-OTR}_{i,t} + \beta_2 \times \text{FEEDUMMY}_t + \\ & \beta_3 \times \text{VWTD-OTR}_{i,t} \times \text{FEEDUMMY}_t + \beta_4 \times \text{AT-INTENSITY}_{i,t} + \beta_5 \times \text{MCAP} \\ & \beta_6 \times \text{INVERSE-PRICE}_{i,t} + \beta_7 \times \text{NIFTY-VOL}_t + \epsilon_{i,t}\end{aligned}$$

	Event 1			**Event 2**		
	$\hat{\beta}_3$	t-stat	R^2	$\hat{\beta}_3$	t-stat	R^2
$\lvert\text{BASIS}\rvert$	**0.10**	4.22	0.19	-0.00	-0.02	0.02
σ_{BASIS}	**0.07**	5.91	0.55	0.00	0.10	0.02

Adverse impact on the informational efficiency in terms of basis post event 1. No effect post event 2.

A closer look at the Event 2 implementation

The 1% LTP limit: % of orders that breached the limit

Event 2:

	Pre	Post	p-value
Average	1.60	1.39	0.07
Median	1.07	1.02	0.24

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Question: If on an average, the % of orders that breached the price limit on a stock in a day was less than 2%, was that the intended target?

Conclusion

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  2. The objective was not well defined.
- The study makes a case for the need of scientific evidence-based policy formulation with defined objectives.

Extensions

- Examine the impact of the other two events:
  a) When the fee was reduced by the exchange on July 1, 2010.
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- Expand the sample universe to all stocks traded on the derivatives segment to understand the impact of the fee on small cap stocks versus the large cap stocks.
- Examine the impact on liquidity provision post the event.
- Examine the profitability of AT to understand if the fee was too small for it to be binding on the actions of algorithmic traders.

Thank you

Comments / Questions?