When do regulatory interventions work?

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Algorithmic and high frequency trading continue to be a source of concern globally.

Exchanges contemplating actions to slow down fast traders – more recently, speed bumps by the futures exchanges (such as the Intercontinental Exchange, LME, Deutsche Borse’s Eurex).

Question: Do such interventions work in line with regulatory concerns?

This paper: Examine the impact of one such intervention, the orders-to-trade ratio (OTR) fee.
The intervention, and the existing studies

- The intervention: Charge fees / penalise traders with high OTR.
- Rationale: High OTR is a negative externality for other market participants. Also, fears of market manipulation.
- Internationally, exchanges including the NASDAQ, OSE, Borsa Italian and TSX have implemented the fee.
- Findings: OTRs decline, but market quality either worsens or remains same.
This paper

- Unique setting where the fee was implemented on the same market at multiple times, by different regulators with different objectives and different design. Provides

- Un-fragmented trading, with almost all of derivatives trading at one exchange. Spot market of the same exchange has more than 75% share. Measure direct and indirect impact of the fee.

- Microstructural features at NSE provide a neat identification strategy.

- Access to trader category data enables us to trace the trader-level impacts, and draw inferences on the underlying economic mechanism.
Impact when the exchange implemented the fee:

- Significant **reduction** in the average OTR of the treated stocks on the SSF market relative to the control stocks.
- Significant **improvement** in liquidity and efficiency measures of these stocks.
- Evidence of migration to spot market based on high OTR
- Trader category impacts: no impact on institutional or proprietary order flow, **reduced** OTR for “retail” (non-institutional, non-proprietary) order flow.
Impact when the market regulator implemented the fee:

- **No significant impact** on either the OTR or any market quality variable.
- Traders modified their behavior by placing orders where the fee did not apply.
Research setting
Rise of algorithmic trading in India, and the OTR fee

When do regulatory interventions work?
1. **2009-10**: Fee applied uniformly across all market participants and order types.

2. **2012-13**: Fee applicable on algo orders only on all order types with the following exemptions:
   1. Orders within +/-1% LTP price limits not included.
   2. Members covered under the LES excluded.
   3. Additional penalty of no trading in the first 15 minutes on the next trading day if OTR > 500.

3. Fee computed at a member level on a daily basis.

4. Fee implemented only on the derivatives segment.
**Data details**

- **Period analysed**: Three months around implementations
     a) Pre event: Jul - Sep 2009
     b) Post event: Oct - Dec 2009
  2. Event 2: Fee hike on SEBI direction on July 2, 2012
     a) Pre event: Apr - Jun 2012
     b) Post event: Jul - Sep 2012

- **Sample**: All securities traded on NSE equity segment.

- **Segment analysed**: Near month single stock futures and cash market.

- **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.
Issues in inference

- In both the events, the fee only implemented on the derivatives segment.
- Use cash market as control? Possible indirect effects:
  1. Substitution effect: Higher cost of trading on derivatives turns traders to the cash market.
  2. Both markets linked by arbitrage. Reduced trading on cash market as well.
- Hence, the inference based on cash market controls likely to be contaminated.
Identification strategy

NSE’s eligibility criteria for selection of securities for derivatives trading:

1. Stock should be in the top 500 stocks in terms of average daily market capitalisation and average daily traded value in the previous six months on a rolling basis.

2. The stock’s median quarter-sigma order size over the last six months shall be not less than Rs. 10 lakhs.

3. The market wide position limit (determined by number of shares held by non-promoters) in the stock shall not be less than Rs. 300 crores.

Some non-derivatives stocks will not meet the above criteria around the thresholds.

We exploit this setting, and match non-derivative stocks with derivative stocks for each event.
Obtaining the set of matched firms

Define

- **Treated**: stocks with derivatives contract within the event window.
- **Comparison**: stocks without derivatives contract.

Match stocks using data **before** the fee implementation,

- **Distance** measure: Propensity score.
- **Covariates**: market cap, price, turnover, number of trades and percentage of floating stock.
- One-to-one matching on estimated propensity scores using the nearest neighbor algorithm (without replacement), and a caliper of 0.05.
Empirical distribution of propensity scores before and after matching

**Event 1**

**Before matching**

**After matching**

**Event 2**

**Before matching**

**After matching**

When do regulatory interventions work?
Impact evaluation: diff-in-diff regression

- Use the treated and control (matched) stocks and estimate the following regression:

  \[ \text{MEASURE}_{i,t} = \alpha + \beta_1 \times \text{TREATED}_{i,t} + \beta_2 \times \text{FEEDUMMY}_{t} + \beta_3 \times \text{TREATED}_{i,t} \times \text{FEEDUMMY}_{t} + \beta_4 \times \text{MCAP}_{i,t} + \beta_5 \times \text{INVERSE-PRICE}_{i,t} + \beta_6 \times \text{NIFTY-VOL}_{t} + \epsilon_{i,t} \]

- Measure ∈ (OTR-measure, market quality measures).
Impact evaluation: diff-in-diff regression

- Use the treated and control (matched) stocks and estimate the following regression:

\[ \text{MEASURE}_{i,t} = \alpha + \beta_1 \times \text{TREATED}_i + \beta_2 \times \text{FEEDUMMY}_t + \beta_3 \times \text{TREATED}_i \times \text{FEEDUMMY}_t + \beta_4 \times \text{MCAP}_{i,t} + \beta_5 \times \text{INVERSE-PRICE}_{i,t} + \beta_6 \times \text{NIFTY-VOL}_t + \epsilon_{i,t} \]

- Measure \( \in \) (OTR-measure, market quality measures).

- Identification assumption: common trends. Tests based on placebo DiD, visual inspection.

- **Hypothesis**: If the event did not have any impact on the level of OTR or market quality, \( \beta_3 = 0 \).
Impact evaluation: diff-in-diff regression

- Use the treated and control (matched) stocks and estimate the following regression:

\[
\text{MEASURE}_{i,t} = \alpha + \beta_1 \times \text{TREATED}_i + \beta_2 \times \text{FEEDUMMY}_t + \\
\beta_3 \times \text{TREATED}_i \times \text{FEEDUMMY}_t + \\
\beta_4 \times \text{MCAP}_{i,t} + \beta_5 \times \text{INVERSE-PRICE}_{i,t} + \\
\beta_6 \times \text{NIFTY-VOL}_t + \epsilon_{i,t}
\]

- Measure ∈ (OTR-measure, market quality measures).
- Identification assumption: common trends. Tests based on placebo DiD, visual inspection.
- **Hypothesis**: If the event did not have any impact on the level of OTR or market quality, \( \beta_3 = 0 \).
- Direct impact on SSF market: DiD regression of treated SSF stocks matched with control stocks on spot market.
- Indirect impact on the spot market: DiD regression of treated stocks on the spot market matched with control stocks on spot market.

When do regulatory interventions work?
Results

When do regulatory interventions work?
# When do regulatory interventions work?

## Impact on OTR

<table>
<thead>
<tr>
<th></th>
<th>Event 1</th>
<th>Event 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treated SSF-Control Spot</td>
<td>Treated Spot-Control Spot</td>
</tr>
<tr>
<td>Fee</td>
<td>0.422** (-2.087)</td>
<td>0.037 (1.711)</td>
</tr>
<tr>
<td>Treated</td>
<td>22.362** (15.115)</td>
<td>0.236** (3.878)</td>
</tr>
<tr>
<td>Treated × Fee</td>
<td>-3.453** (-3.191)</td>
<td>0.325** (5.613)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.65</td>
<td>0.34</td>
</tr>
<tr>
<td># of obs</td>
<td>6060</td>
<td>6715</td>
</tr>
</tbody>
</table>
Decomposing the source of OTR effects
NINP = retail; INST = institutional; PROP = proprietary

<table>
<thead>
<tr>
<th></th>
<th>Treated(SSF)-Control(Spot)</th>
<th>Treated(Spot)-Control(Spot)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OTR_NINP</td>
<td>OTR_INST</td>
</tr>
<tr>
<td><strong>Fee</strong></td>
<td>-0.157</td>
<td>0.091</td>
</tr>
<tr>
<td></td>
<td>(-0.866)</td>
<td>(1.198)</td>
</tr>
<tr>
<td><strong>Treated</strong></td>
<td>16.355**</td>
<td>3.972**</td>
</tr>
<tr>
<td></td>
<td>(13.095)</td>
<td>(9.649)</td>
</tr>
<tr>
<td>Treated \times Fee</td>
<td>-4.149**</td>
<td>-0.673</td>
</tr>
<tr>
<td></td>
<td>(-4.423)</td>
<td>(-1.677)</td>
</tr>
<tr>
<td><strong>Adjusted R^2</strong></td>
<td>0.53</td>
<td>0.18</td>
</tr>
<tr>
<td><strong># of obs</strong></td>
<td>6060</td>
<td>5253</td>
</tr>
</tbody>
</table>

When do regulatory interventions work?
# OTR fee impact on orders placed beyond 1% LTP, Event 2

When do regulatory interventions work?

<table>
<thead>
<tr>
<th></th>
<th>Treated(SSF)-Control(Spot)</th>
<th>Treated(Spot)-Control(Spot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORDERS-BEYOND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fee</td>
<td>-2.669</td>
<td>-3.471**</td>
</tr>
<tr>
<td></td>
<td>(-1.805)</td>
<td>(-2.359)</td>
</tr>
<tr>
<td>Treated</td>
<td>-3.462</td>
<td>11.425**</td>
</tr>
<tr>
<td></td>
<td>(-1.004)</td>
<td>(3.677)</td>
</tr>
<tr>
<td>Treated × Fee</td>
<td>-12.182**</td>
<td>-7.012**</td>
</tr>
<tr>
<td></td>
<td>(-4.09)</td>
<td>(-2.63)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.22</td>
<td>0.30</td>
</tr>
<tr>
<td># of obs</td>
<td>7485</td>
<td>9514</td>
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</tbody>
</table>
### Impact on market quality: Event 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treated(SSF)-Control(Spot)</th>
<th>Treated(Spot)-Control(Spot)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\hat{\beta}_3$</td>
<td>t-stat</td>
</tr>
<tr>
<td>QSPREAD</td>
<td>-0.06**</td>
<td>-6.80</td>
</tr>
<tr>
<td>$IC_{250k}$</td>
<td>-0.03**</td>
<td>-2.71</td>
</tr>
<tr>
<td>$IC_{500k}$</td>
<td>-0.05**</td>
<td>-3.41</td>
</tr>
<tr>
<td>TOP1DEPTH</td>
<td>0.13**</td>
<td>2.53</td>
</tr>
<tr>
<td>TOP5DEPTH</td>
<td>0.15**</td>
<td>2.59</td>
</tr>
<tr>
<td>ILLIQ</td>
<td>-0.00**</td>
<td>-2.08</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>-7.47**</td>
<td>-5.73</td>
</tr>
<tr>
<td>$\sigma_{IC,250k}$</td>
<td>-0.05**</td>
<td>-4.15</td>
</tr>
<tr>
<td>$\sigma_{IC,500k}$</td>
<td>-0.06**</td>
<td>-4.55</td>
</tr>
<tr>
<td>$</td>
<td>VR - 1</td>
<td>$</td>
</tr>
</tbody>
</table>

When do regulatory interventions work?
## Impact on market quality: Event 2

<table>
<thead>
<tr>
<th></th>
<th>Treated(SSF)-Control(Spot)</th>
<th>Treated(Spot)-Control(Spot)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\hat{\beta}_3$</td>
<td>t-stat</td>
<td>Adj-R²</td>
</tr>
<tr>
<td>QSPREAD</td>
<td>-0.04**</td>
<td>-3.20</td>
<td>0.56</td>
</tr>
<tr>
<td>IC$_{250k}$</td>
<td>-0.01</td>
<td>-0.46</td>
<td>0.32</td>
</tr>
<tr>
<td>IC$_{500k}$</td>
<td>-0.01</td>
<td>-0.76</td>
<td>0.30</td>
</tr>
<tr>
<td>TOP1DEPTH</td>
<td>0.09</td>
<td>1.04</td>
<td>0.76</td>
</tr>
<tr>
<td>TOP5DEPTH</td>
<td>0.14</td>
<td>1.40</td>
<td>0.67</td>
</tr>
<tr>
<td>ILLIQ</td>
<td>0.00</td>
<td>0.16</td>
<td>0.11</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>-5.57**</td>
<td>-2.99</td>
<td>0.45</td>
</tr>
<tr>
<td>$\sigma_{IC,250k}$</td>
<td>-0.00</td>
<td>-0.07</td>
<td>0.08</td>
</tr>
<tr>
<td>$\sigma_{IC,500k}$</td>
<td>-0.01</td>
<td>-0.60</td>
<td>0.03</td>
</tr>
<tr>
<td>$</td>
<td>VR - 1</td>
<td>$</td>
<td>0.01</td>
</tr>
</tbody>
</table>

When do regulatory interventions work?
• **Event 1**: agents sensitive to the fee directly impacted, modified their behavior via reduction in OTR, and migrating some trading activity to the other venue.

• This brought back the liquidity providers who were earlier crowded out by the activity of these *noise* traders.

• **Event 2**, agents modified their behavior by placing orders where the fee was exempted.

• Thus, no impact on OTR and market quality.
Conclusion

- Regulatory interventions are justified when they are targeted to solve a market failure.
- In the absence of a well-defined market failure, it is unclear what is being targeted, and how the proposed intervention will impact the target.
- In the case of the OTR fee, the intervention achieved its intended outcome when the root cause of the problem was well-identified.
- This was not the case in the second event, or and it is unclear if the intervention was only motivated by the need to ‘do something’.
- Such interventions increase the costs for the market participants and has implications for the long term growth of markets.
- The evidence thus emphasises on the need for evidence-based policy formulation with well-defined objectives.
Thank you.

Comments / Questions?