Tick Size Wars. Competitive Tick Size Regimes and Trader Behavior

Sean Foley,\textsuperscript{a} Tom Grimstvedt Meling\textsuperscript{b}
and
Bernt Arne Ødegaard\textsuperscript{c}

\textsuperscript{a}University of Sydney \textsuperscript{b}University of Chicago \textsuperscript{c}University of Stavanger

3rd SAFE Market Microstructure Conference, Aug 2019
1. Intro

2. Events of War

3. Effect on Market Quality of first lowering of tick sizes

4. Total effects – pre to post harmonization

5. Main market constrained?

6. Quoting behavior in small-tick market

7. Conclusion
Introduction

The tick size in equity market design

- *Tick size*: the grid of possible price increments on a stock exchange.
- Choice variable in the design of a limit order market.
- World-wide trend towards smaller tick sizes

Too little liquidity provision?

- Claim: Current tick size too small — deters intermediaries from providing liquidity
- US response: Tick Size Pilot — pilot program experimentally increased tick size – not successful
- EU response: MiFID II – tick size contingent on stock liquidity (in addition to price)
Market Fragmentation

- Tick sizes fix terms of trade in an exchange.
- Competing exchanges “improve” on fixed tick sizes by
  - Midpoint execution (Kwan, Masulis, and McInish, 2015; Buti, Rindi, and Werner, 2017)
  - Fee structure changing implied ticks (maker-taker vs taker-maker). (Chao, Yao, and Ye, 2019; Comerton-Forde, Grégoire, and Zhong, 2019).
- Each regulatory intervention seeking to eliminate implicit competition met by ever more imaginative structures.
This study

- The impacts of pure exchange tick size competition
- The immediate responses of HFT liquidity suppliers

Investigate 2009 “Tick Size War” between

- Established Exchanges: LSE, Copenhagen, Oslo, Stockholm

Unique case of using tick size lowering as a competitive move.
The Tick Size Wars of ’09

In the left corner....
• 2007: MiFID
• 2008: Chi-X, BATS, Turquoise starts trading limited range UK, Scandinavian stocks.
• June 2009: Chi-X, BATS, Turquoise reduces tick sizes selected LSE, Scandinavian stocks.
• Later that month: LSE reacts, all exchanges trade London shares on new lower tick.
• Early July: OSE reacts, competitive lowering of tick sizes, but still higher than competitors.
• Fall: Pan-European agreement on common tick sizes across all exchanges.
Market aggregate: Relative Tick (Oslo)

The graph shows the relative tick size for different markets from May to November. The y-axis represents the relative tick size (%) ranging from 0.00 to 0.20. The x-axis represents the months from May to November.

- **OSE** (black line): Generally shows a decrease in relative tick size from May to August, followed by a slight increase in September and October before stabilizing in November.
- **Chi-X** (dashed blue line): Begins with a stable period from May to July, then drops significantly in August, maintaining a low level through October before increasing in November.
- **BATS** (dashed red line): Starts with a gradual decrease, reaching a peak in August, followed by a sharp drop in September, and a stabilization in October before rising in November.
- **Turquoise** (dotted green line): Displays a pattern of fluctuations, reaching a peak in August, declining in September, and stabilizing in October before rising slightly in November.

The graph indicates trends and changes in relative tick sizes across these markets over time.
Consequence 1: Pre-trade market share

Scandinavian exchanges *overnight*

- go from quoting the best price all the time to 50% of the time.
Consequence 2: post-trade market share

Scandinavian exchanges *overnight*
- lose 3-4% market share.

![Graph showing market share changes over time](chart.png)
Effect on market quality of first lowering of tick sizes

- Spreads (transaction costs) fall in both away and home markets
- Depth is unchanged
- Volume increases in both home and away markets.
Spread (NBBO) around first move
Diff-in-Diff regression – quality effects of first move

Diff in diff formulation:

- Stocks with significant cross-market trade (stocks in Scandinavian main indices).
- Control in diff-in-diff: Stocks only traded at the listing exchanges.
## Diff-in-Diff regression – quality effects of first move

<table>
<thead>
<tr>
<th></th>
<th>Home</th>
<th>Away</th>
<th>NBBO</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \tau ) (Quoted spread)</td>
<td>(-0.08^{***})</td>
<td>(-0.33^{***})</td>
<td>(-0.20^{***})</td>
</tr>
<tr>
<td></td>
<td>((-4.40))</td>
<td>((-12.30))</td>
<td>((-8.39))</td>
</tr>
<tr>
<td>( \tau ) (Effective spread)</td>
<td>(-0.09^{***})</td>
<td>(-0.27^{***})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>((-4.24))</td>
<td>((-10.86))</td>
<td></td>
</tr>
<tr>
<td>( \tau ) (Realized spread)</td>
<td>(-0.15^{***})</td>
<td>(-0.31^{***})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>((-3.94))</td>
<td>((-7.31))</td>
<td></td>
</tr>
<tr>
<td>( \tau ) (Price impact)</td>
<td>(-0.05)</td>
<td>(-0.24^{***})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>((-1.51))</td>
<td>((-5.73))</td>
<td></td>
</tr>
<tr>
<td>( \tau ) (Depth)</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(-0.16)</td>
<td></td>
</tr>
<tr>
<td>( \tau ) (Volatility)</td>
<td>(-0.06)</td>
<td>0.05*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>((-0.65))</td>
<td>(1.80)</td>
<td></td>
</tr>
<tr>
<td>( \tau ) (Volume)</td>
<td>0.12^{***}</td>
<td>0.66^{***}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.65)</td>
<td>(13.68)</td>
<td></td>
</tr>
</tbody>
</table>

# treated RICs    89   222
# control RICs    577   577

---

University of Stavanger
Total effects – pre-war to post-harmonization

- Spreads (transaction costs) fall in both away and home markets
- Depth falls
- Volume
  - decreases in home markets.
  - increases in away markets.
Spread (NBBO) throughout the war
Depth throughout the war (Oslo)
Technicalities:

Want: change in quality measures linked to tick size.

Diff in diff

- Stocks with significant cross-market trade (stocks in Scandinavian main indices).
- Control: Stocks only traded at the listing exchanges.
- Timing: Each market:
  - Short period before initial tick size lowering
  - Short period after harmonization in that market
# Diff-in-Diff Regression - overall effects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Home</th>
<th>Away</th>
<th>NBBO</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau$ (Quoted spread)</td>
<td>-0.49***</td>
<td>-0.59***</td>
<td>-0.63***</td>
</tr>
<tr>
<td></td>
<td>(-10.16)</td>
<td>(-13.02)</td>
<td>(-13.46)</td>
</tr>
<tr>
<td>$\tau$ (Effective spread)</td>
<td>-0.62***</td>
<td>-0.76***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-12.62)</td>
<td>(-19.47)</td>
<td></td>
</tr>
<tr>
<td>$\tau$ (Realized spread)</td>
<td>-0.89***</td>
<td>-1.21***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-11.56)</td>
<td>(-17.44)</td>
<td></td>
</tr>
<tr>
<td>$\tau$ (Price impact)</td>
<td>-0.42***</td>
<td>-0.56***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-9.20)</td>
<td>(-11.15)</td>
<td></td>
</tr>
<tr>
<td>$\tau$ (Depth)</td>
<td>-0.93***</td>
<td>-0.16***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-13.20)</td>
<td>(-3.81)</td>
<td></td>
</tr>
<tr>
<td>$\tau$ (Volatility)</td>
<td>-0.00</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.04)</td>
<td>(1.44)</td>
<td></td>
</tr>
<tr>
<td>$\tau$ (Volume)</td>
<td>-0.15***</td>
<td>0.92***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.72)</td>
<td>(11.28)</td>
<td></td>
</tr>
</tbody>
</table>

# treated RICs      67     200
# control RICs      577    577

The table reports estimates from the following difference-in-differences regression specification:

$$y_{it} = \alpha_i + \beta Post_{it} + \gamma Post_{it} \times \alpha_m + \tau D_H_{it} + X_{it} + \omega_{it},$$

where $\alpha_i$ and $\alpha_m$ represent RIC and market-level fixed effects, respectively.

$D_H_{it} = 1$ for all treatment group observations on dates $t \geq t^*$, where $t^*$ is tick size harmonization date for a given stock exchange. $Post_{it} = 1$ for all observations after tick size harmonization in a given market. $X_{it}$ is a vector of control variables, comprising the natural logarithm of the stock price. Our treatment sample consists of blue-chip index stocks that experienced tick size harmonization. Our control sample consists of all home exchange stocks that did not experience tick size harmonization. The sample period comprises one month of data from the pre-war period (May, 2009) and one month of data from after each of Norwegian, Danish, and Swedish harmonization events (August 31, 2009, October 26, 2009, and January 4, 2010, respectively). The difference-in-differences specification is estimated pooled for all stocks, regardless of whether they experienced increased or reduced tick size (only six stocks experienced increased tick size).

$Qspread$ is the quoted relative spread, transformed with the natural logarithm. $Espread$ is the effective spread, transformed with the natural logarithm. $Depth$ is order book depth, transformed with the natural logarithm. $Volatility$ is measured in percentage points. $Volume$ is currency trading volume, transformed with the natural logarithm. For ease of exposition, we have included $N$, the number of observations, only for regressions using $Volume$ as the dependent variable. The number of observations varies slightly across dependent variables. $t$-statistics are presented in parentheses. Standard errors are clustered at the RIC-level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Does tick sizes constrain?

Tick sizes lower bound on bid/ask spread. If trading at one tick, trading costs can’t go lower. Were these markets constrained?

Stockholm: Fraction of the day quoting at one tick.

Results

Effects on market quality concentrated in stocks which are constrained at one tick.
Competition from small-tick markets

Large Tick Exchange

Best bid → | | | | | | | | Best ask ←

Small Tick Exchange

Possible price improvements
Possibilities

- Undercutting of prices at the large-tick exchange?
- Price competition at the small-tick exchange?

**Large Tick Exchange**

Best bid → | | | | | | Best ask ←

**Small Tick Exchange**

New equilibrium?
Chi-X improvement on OSE price

Fraction of day Chi-X improves on OSE price
What are traders using small-tick market for?

Same as main (or worse)

Best bid

Improve more than one tick

Improve just one tick"
Placing of Chi-X quotes relative to main market

When tick sizes are the same:

![NHY 29 May 2009 Diagram](image-url)
Placing of Chi-X quotes relative to main market

When Chi-X tick sizes are smaller:
How often does Chi-X improve by more than one tick?
HFT traders at the small-tick markets

- Use the small-tick markets to undercut main market by minimal ticks.
- Do *not* use to the small-tick market to move prices towards a less constrained equilibrium.
Minimal effect on NBBO

Relative Spreads for OSE stocks
'09 Tick Size War: Exchanges’ competitive lowering tick size

- Entrant exchanges undercut to gain market share.
- Immediate loss of market for old exchanges:
  - 100% → 50% time at best quote
  - 98% → 92% trading volume
- Market quality effects: pre-war → post-war (post-harmonization)
  - Spreads (transaction costs) fall in both away and home markets
  - Depth falls
  - Volume
    - decreases in home markets.
    - increases in away markets.
- Quoting behavior: Traders use small-tick market to undercut main market by one tick, not for price competition on the small-tick market.
• Explicit tick size competition leads to undercutting behavior.
• HFT market makers undercut by only one new tick – No new “equilibrium” spread.
• Regulation required to avoid explicit tick size competition.
• With regulation requiring harmonized ticks, implicit competition emerges
  • Midpoint Dark Trading (Europe)
  • Fractional Dark Trading (US)
  • Large in Scale Blocks
  • Inverted Fee Venues
• Narrower unconstrained tick sizes may eliminate this competitive conduct.
Example: Spread of BP at LSE
BP: Turquoise quote placement relative to LSE
BP: Fraction at best bid
BP: Aggregate depth at LSE quotes

