A Cloaking Mechanism to Mitigate Market Manipulation

Xintong Wang, Yevgeniy Vorobeychik, Michael P. Wellman
July 2018
As ‘Spoof’ Trading Persists, Regulators Clamp Down
Bluffing Tactic That Dodd-Frank Banned in 2010 Can Distort Markets

UBS, Deutsche Bank and HSBC to pay millions in spoofing settlement, CFTC says

- Deutsche Bank will pay $30 million, UBS $15 million and HSBC $1.6 million to settle civil charges that some of their traders engaged in spoofing in the precious metals market.
- The CFTC charged six individuals, and the Department of Justice charged eight with crimes related to deceptive trading in a wide-ranging investigation.

By BRADLEY HOPE
Updated Feb. 22, 2015 10:34 p.m. ET

CHICAGO—One June morning in 2012, a college traders call “The Russian” logged on to his commodity futures on a London exchange from his sky

Over six hours, Igor Ostertag’s computer sent thousands of buy and sell orders, scaring the exchange to his clearing firm reviewed by the canceled many of those orders milliseconds after the exchange, what the exchange alleges was part of a trick others into buying and selling at a

Traders call the illegal bluffing tactic “spoofing,” used to manipulate prices of anything from stock

Liz Mayer
Published 2:29 PM ET Mon, 29 Jan 2018 | Updated 8:32 AM ET Wed, 31 Jan 2018

Flash Crash Trader E-Mails Show Spoofing Strategy, U.S. Says

10:03 PM EDT Updated on September 4, 2015 — 9:32 AM EDT

US seals first prosecution against stock market trader for 'spoofing'
A jury convicts Michael Coscia on six charges of commodities fraud and six charges of spoofing, all of the charges he faced

Prosecutors said Michael Coscia wanted to lure other traders to markets by creating an illusion of demand so that he could make money on smaller trades

By Reuters
11:48PM GMT 03 Nov 2015
A US jury has found high-frequency trader Michael Coscia guilty of
Spoofing refers to the practice of submitting large spurious orders to buy or sell some security to mislead other traders’ beliefs.
Best Bid

*the market’s highest buy price*

Best Ask

*the market’s lowest sell price*
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Best Bid

Best Ask

True buy order

Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
Source: Financial Conduct Authority, Animated Example of Mr Coscia’s Trading
### Standard CDA Mechanism

<table>
<thead>
<tr>
<th>CDA</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASK\textsuperscript{1}</td>
<td>ASK\textsuperscript{1}</td>
<td>ASK\textsuperscript{1}</td>
<td>ASK\textsuperscript{1}</td>
<td>ASK\textsuperscript{1}</td>
<td>ASK\textsuperscript{1}</td>
<td>ASK\textsuperscript{1}</td>
</tr>
<tr>
<td></td>
<td>BID\textsuperscript{1}</td>
<td>BID\textsuperscript{1}</td>
<td>BID\textsuperscript{1}</td>
<td>BID\textsuperscript{1}</td>
<td>BID\textsuperscript{1}</td>
<td>BID\textsuperscript{1}</td>
<td>BID\textsuperscript{1}</td>
</tr>
<tr>
<td>t</td>
<td>t+1</td>
<td>t+2</td>
<td>t+3</td>
<td>t+4</td>
<td>...</td>
<td>T</td>
<td></td>
</tr>
</tbody>
</table>

- Provides the chance to quickly react to the market fluctuation.
A Cloaking Mechanism

- Hides a deterministic number of price levels $K$ from inside of the book.
- Introduces risk and degrades influence of manipulative practice.
A Cloaking Mechanism

- Hides a deterministic number of price levels $K$ from inside of the book.
- Introduces risk and degrades influence of manipulative practice.
A Cloaking Mechanism

- Hides a deterministic number of price levels $K$ from inside of the book.
- Introduces risk and degrades influence of manipulative practice.
- Preserves the usefulness of aggregated market information.
Motivating Questions

• Can cloaking effectively and robustly mitigate market manipulation?
• Under what circumstances and to what degree should the mechanism cloak?
Agent-Based Simulation

- Simulate financial markets as complex multi-agent systems.
- Elucidate the strategic choices faced by market participants.
- Evaluate market performance and the impact of cloaking given agent interactions at Nash equilibrium.
Trading Agents

**Background Traders:** Investors with preference on longing or shorting.

Zero intelligence (ZI) [Gode & Sunder 1993]

Agents bid based on its private valuation and a stochastic requested surplus.

+ Robust to market manipulation.
– Not as competitive as learning traders.
Trading Agents

**Background Traders**: Investors with preference on longing or shorting. Heuristic belief learning (HBL) [Gjerstad & Dickhaut 1998]

Agents learn from the *visible* order book in memory to approximate the probability of an order being accepted and choose a bid price to maximize expected surplus.

+ Improves market convergence, price discovery and social welfare.
  – Susceptible to order-based manipulation.
**Trading Agents**

**Exploiter:**
Accepts any sell order at price lower than a certain threshold;
Chooses to spoof or wait (strategically);
Accepts any buy orders at higher prices.

“Safe” manipulation: spoofs at a tick behind the _visible_ best bid to push price up.
Market Model

- Fundamental shock $\sigma^2_s$.
- Observation noise $\sigma^2_n$.

<table>
<thead>
<tr>
<th>Env</th>
<th>LSHN</th>
<th>MSMN</th>
<th>HSLN</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2_s$</td>
<td>$10^5$</td>
<td>$5 \times 10^5$</td>
<td>$10^6$</td>
</tr>
<tr>
<td>$\sigma^2_n$</td>
<td>$10^9$</td>
<td>$10^6$</td>
<td>$10^3$</td>
</tr>
</tbody>
</table>

- Presence of manipulation.
- Different degree of cloaking. $K = \{0, 1, 2, 4\}$
Experiments and Results

- The impact of cloaking on background traders
- The impact of cloaking on manipulation
- Finding the optimal cloaking K
- Exploring smarter manipulation strategy
A Cloaking Mechanism: the Tradeoff

![Graph 1: HBL Adoption Rate](image)

- HBL% in markets w/o spoofing

![Graph 2: Surplus in markets w/o spoofing](image)

- Surplus in markets w/o spoofing
A Cloaking Mechanism: the Tradeoff

Too much cloaking weakens HBL’s ability to make prediction, causing a decrease in HBL fraction and surplus at equilibrium.
A Cloaking Mechanism: the Tradeoff

Too much cloaking weakens HBL’s ability to make prediction, causing a decrease in HBL fraction and surplus at equilibrium.

Cloaking diminishes price distortion caused by manipulation and reduces spoofing profits.
Experiments and Results

The impact of cloaking on background traders

Finding the optimal cloaking K

Exploring smarter manipulation strategy

The impact of cloaking on manipulation
A Cloaking Mechanism: the Optimal $K$
A Cloaking Mechanism: the Optimal $K$
Experiments and Results

The impact of cloaking on background traders

Finding the optimal cloaking K

Exploring smarter manipulation strategy

The impact of cloaking on spoofing
Trading Agents

**Exploiter**: Accepts any sell order at price lower than a certain threshold;Spoofs or waits;Accepts any buy orders at higher prices.

“Safe” manipulation: spoofs at a tick behind the *visible* best bid to push price up.

“Risky” manipulation: *probes* the market, submitting a series of orders at higher prices to reveal the cloaked bids and spoof at higher prices.
Probe the Cloaking Mechanism

\[ \delta : \text{the probing step size.} \]

\[ l : \text{maximum number of attempts per time step.} \]
Probe the Cloaking Mechanism

\[ \delta : \text{the probing step size.} \]

\[ l : \text{maximum number of attempts per time step.} \]

\[ \text{ASK}^1 \]
\[ \text{BID}^1 \]

2
Probe the Cloaking Mechanism

\[ \delta \] : the probing step size.

\[ l \] : maximum number of attempts per time step.

---

\[ \text{ASK}^1 \]

\[ \text{BID}^1 \] 3

---
Probe the Cloaking Mechanism

\[ \delta : \text{the probing step size.} \]

\[ l : \text{maximum number of attempts per time step.} \]

\[ \begin{array}{c}
\text{ASK}^1 \\
\text{BID}^1 \\
\text{BID}^1 - 1 \\
\end{array} \]

\[ \uparrow \delta \]
Probe the Cloaking Mechanism

The effort and risk of probing a cloaking mechanism in highly dynamic markets usually exceed the gains.
Summary

- Can cloaking effectively and robustly mitigate market manipulation?
- Under what circumstances and to what degree should the mechanism cloak?

The impact of cloaking on background traders

Finding the optimal cloaking K

Exploring smarter manipulation strategy

- Cloaking reduces HBL% and surplus in Eq.
- Cloaking diminishes the efficacy of spoofing.
- The benefit of cloaking to deter spoofing can outweigh its cost.
- The effort and risk of smart spoofing exceed the gains

Thank you, questions? Poster #83