Spoofing in Equilibrium

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Motivation

In 2010, the Dodd-Frank act made illegal a form of price manipulation called *spoofing:*

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Since then, regulators have steadily increased anti-spoofing enforcement.

- 2018: CFTC creates special task force on spoofing
- 2020: JP Morgan fined $920 million

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But very little scholarship on this, empirical or theoretical.

Contribution

1. Build a tractable model in which spoofing occurs in equilibrium.
2. Examine spoofing's effect on markets.
3. Characterize market conditions that make spoofing more likely.
4. Characterize optimal regulation of spoofing.

Approach

In practice, spoofing takes place dynamically via limit orders—hard to model analytically.

- *Dynamic limit order models:* Goettler, Parlour, Rajan (2005, 2009), solved numerically.

Our workaround: Adapt the Glosten-Milgrom *market* order setting, adding order cancellations.

- Tractably captures the essential feature of limit orders that make them useful for spoofing.

Model

Environment

- Three dates: 1, 2, and 3
- Players: A competitive market maker and a large number of traders.
- Players exchange units of an asset, which has fundamental value $v \in \{-1, 1\}$, equal probability. Value v revealed publicly at date 3.

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5. If order isn't cancelled (C), it is executed (E) at the ask price (for buy orders B) or bid price (for sell orders S).

Heterogeneous Traders

Information about asset value v:

- Fraction α are informed.
- Fraction $1-\alpha$ are uninformed; half are buyers, half are sellers.

Time Horizon:

- Fraction λ are *long-term*: if he arrives at the market at date 1, he also arrives *anonymously* at date 2.
- Fraction $1-\lambda$ are *short-term*: if he arrives at the market at date 1, a *different* short-term trader arrives at date 2.

Information and horizon are independent.

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Presence of long-term traders makes strategies more complex than in Glosten-Milgrom.

Short-term Trader Strategies

If a short-term trader arrives at the market, that is his only opportunity to trade, so he will not strategically cancel.

Informed short-term:

- Will buy if asset value is high.
- Will sell if asset value is low.

Uninformed short-term:

- Half will buy, half will sell.

Long-term Trader Strategies

Definition 1

1. *A trader places a direct order if he submits an order and does not strategically cancel it.*
2. *A trader spoofs if he places an order at date 1, cancels it strategically, and then places an opposite direct order at date 2.*

Can it be an equilibrium for the long-term traders to spoof? Compare:

- the price he pays for spoofing
- the price he pays for deviating by placing a direct order.

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So the price for spoofing, a weighted average of the two expectations, is *less than* the price $\mathbb{E}[V|BE]$ for buying directly.

Equilibrium Spoofing

Proposition 1

In the unique equilibrium, long-term traders spoof, and short-term traders place direct orders.

The market maker cannot tell if cancellations are spoofers, so because there is some chance that canceled orders are sincere, he updates the price in the spoofer's desired direction.

Market Consequences of Spoofing

Benchmark

Benchmark: Suppose long-term traders are simply forced to trade directly.

How do market outcomes in the benchmark compare to the case in which long-term traders spoof?

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1. **Slower price discovery:** Date 2 prices are further from the true value v.
2. **Higher spreads:** Market maker raises spreads to compensate for increased adverse selection.
3. **Higher volatility:** Spoofing leads market maker away from true asset value, which then corrects when value is revealed.

Market Conditions That Favor Spoofing

Endogenous Measure of Spoofers

Suppose there is an expected penalty $k > 0$ of being caught spoofing by a monitor.

Proposition 2

1. *There exists a unique equilibrium measure σ of spoofers, which is decreasing in the expected penalty k of being caught spoofing.*

- If the expected penalty k is high, only high gains can justify spoofing.
- Spoofing is most profitable when few spoof (σ is low), because the market maker maker regards canceled orders as more informative of value.

Intermediate Liquidity Invites Spoofing

Proposition 3

The equilibrium measure of spoofers σ is single-peaked in the measure α of informed traders.

Intuition:

- If α is low, orders move the price very little, so spoofing is not very profitable.
- If α is high, orders in opposite directions strongly indicate spoofing, resulting in a similar price as for a direct order.

Spoofers like markets that are illiquid enough to move the price, but not so illiquid that their trading pattern stands out.

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Conventional wisdom: Illiquid markets are more prone to manipulation, because trades have greater price impact, easier to manipulate.

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- Most SEC litigated manipulation occurs in small, illiquid markets.
- Conditional on those markets, manipulation is *increasing* in market liquidity. Result likely understated, as greater liquidity allows manipulators to blend in with more trading activity.

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Our model has both effects: spoofers like markets which are illiquid enough to move the price, but not so illiquid that they can't blend in.

Cancellations Invite Spoofing

Proposition 4

The measure of spoofers σ is increasing in the probability β of legitimate cancellation.

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Implication: Even if HFT's are not manipulating, they create conditions that attract spoofing.

Risk of Unintended Execution

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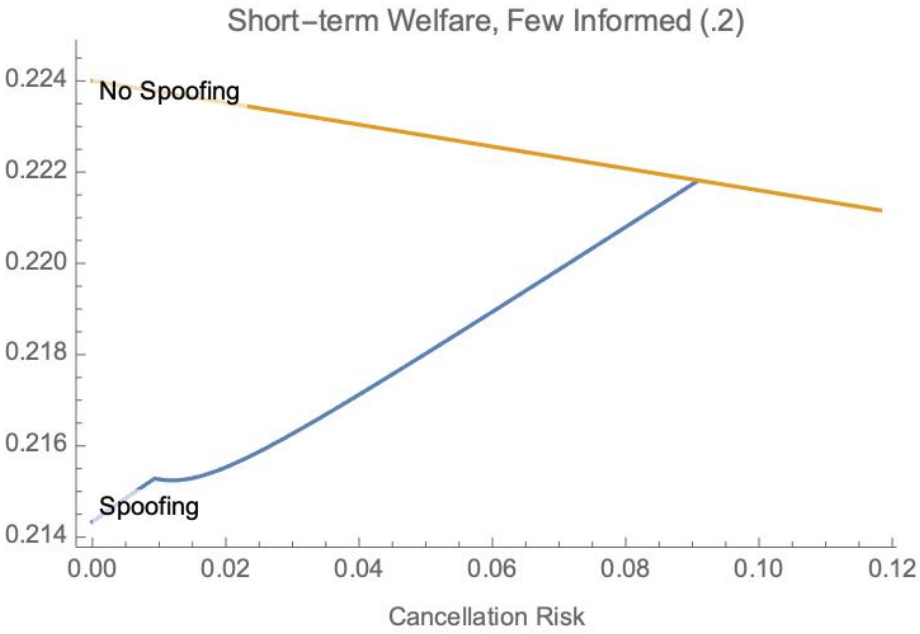
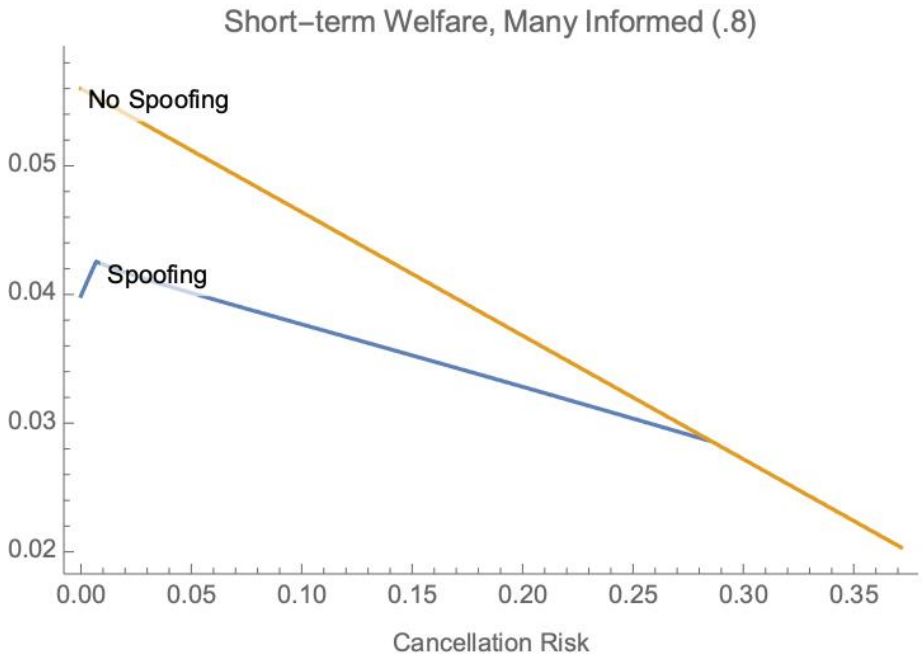
- But would affect both spoofing and legitimate cancellation—how to think about optimal regulation?

Welfare of Short-Term Traders





Summary

A stylized model of spoofing.

Delivers predictions in line with regulator concerns and data.

1. Market consequences of spoofing
   - Slower price discovery, higher bid-ask spreads, higher volatility.
2. Conditions that invite spoofing:
   1. Moderately liquid market, many cancellations.
3. Cancellation Risk
   - Discourages spoofing, and also harms legitimate cancellations
   - Optimal risk (for legitimate traders) depends on α (how costly unintended execution is).