Spoofing the Limit Order Book: An Agent-Based Model

Xintong Wang and Michael P. Wellman
Computer Science and Engineering, University of Michigan, Ann Arbor

Spoofing, a type of financial market manipulation, refers to the practice of submitting large spurious orders to buy or sell some security to mislead other traders’ beliefs.

Source: Financial Conduct Authority, Animated Example of Mr. Coscia’s Trading

Questions:
- Can we model a market where spoofing effectively manipulates rational traders’ beliefs about prices?
- What is the impact of spoofing? Can we quantify the effect?

Approach:
- Simulate financial markets as complex multi-agent systems.
- Elucidate the strategic choices faced by market participants.
- Evaluate market performance given agent interactions at empirical Nash equilibrium.

Contributions:
- Adapt HBL trading agents to a complex market environment.
- Demonstrate the effectiveness of adapted HBL and the usefulness of order book information.
- Provide the first computational model of spoofing a limit-order market.

Agent-Based Market Model

Agent Composition

Background Traders:
- Heuristic belief learning (HBL) [Gjerstad & Dickhaut 1998] agents learn from market activities to approximate the probability of an order being accepted and choose a bid price to maximize expected surplus.

Spoofers:
- Maintains a large volume of buy orders at one tick behind the best bid, aiming to push price up.

Source:

Motivation

Spurious Spoothing, a type of financial market manipulation, refers to the practice of submitting large spurious orders to buy or sell some security to mislead other traders’ beliefs.

Market Model

- Observe fundamental value with noise.
- Estimate current fundamental.
- Estimate final fundamental.
- Submit a single unit order at price jointly decided by valuation and strategy.

- Markets with different levels of shocks and observation noise, which affect fundamental estimation and price prediction.
- Markets with different numbers of background traders, which affect the amount of aggregated information.
- Markets with and without spoofing.

Experiments and Results

Without Spoofing

With Spoofing

Stage 1: HBL as a strategic choice can improve price discovery and surplus.

Stage 2: Spoofing can effectively manipulate markets with HBL and cause a surplus redistribution.

Stage 3: Spoofing tends to decrease HBL proportion and market surplus.

* Note: plots shown are outcomes based on markets with 65 background traders. Paper includes results on more market environments.