Competition Between Financial Exchanges

Can Frequent Call Mechanisms Drive Trade Away from CDAs?

Zhuoshu Li and Sanmay Das
Washington University in St. Louis
Continuous Double Auction (CDA)
— Continuous time trading
High frequency trading

ARMS RACE
liquidity
price discovery
faster: more profit

Brogaard et al, 2014
Menkveld, 2011
High frequency trading

Market instabilities
Social cost of the “arms race”
Who gets the benefits?

Kirilenko et al, 2014
Proposed Response: Frequent call markets

- Wah and Wellman 2013
- Budish et al 2015
Can Frequent Call Mechanisms Drive Trade Away from CDAs?

• *Wah et al 2015*: Empirical game-theoretic analysis with agents choosing one market at the beginning.

• *This paper*: Competition; traders have the option to place an order in either of the markets at any time.
COMPETING-MARKET MODEL

Frequent call market can drive trade away
❈ Competing-market model

• Model components
True value: $\nu_t$

CDA market

Call market
BUY: $ 25
SELL: $ 50
BUY: $ 10

Arrive at market: Poisson process

CDA market
Call market

SELL: $ 30 ← modify

Trader
Traders

Informed traders
• *patient, only profit*
• *no buy/sell need*

Background traders**
• *impatient, demand immediacy*
• *with buy/sell need*

Traders

Informed traders

\[ i : w_{i,t} \sim \mathcal{N}(v_t - \delta, \sigma) \]

Background traders**

*no private information, take any price*

• Competing-market model
  ✓ Model components
  • Trading strategies
Strategies — *market choice*

Informed traders

Market: Larger belief distance $\rightarrow$ $$$

Background traders

Compare the price in both markets

*belief distance*

- trader’s belief
- CDA Market price
- Call Market Price
Strategies — *order price*

Informed traders: *Zero Intelligence (ZI)*

- Market price
- Order price
- >Private: sell
- <Private: buy
- Place order
Strategies — order price

Background traders

decide direction → market order → executed or wait
† Competing-market model

✓ Model components

✓ Trading strategies

• Key measure
Key measure

✧ Price of immediacy
  • Expected loss of background traders
Results

- Individual markets
- Competing markets with fixed strategies
- Competing markets with learned strategies
Results

• Individual markets

• Competing markets with fixed strategies

• Competing markets with learned strategies
Results

✓ Individual markets

• Competing markets with fixed strategies
• Competing markets with learned strategies
Results

✓ Individual markets

• Competing markets with fixed strategies
• Competing markets with learned strategies
Proportion of orders

CALL | CDA

HFT | non-HFT | BG
Results

✓ Individual markets

✓ Competing markets with fixed strategies

• Competing markets with learned strategies
Results

- Individual markets
- Competing markets with fixed strategies
  - Competing markets with learned strategies
Expected profit given belief distance

strategy: fixed policy, which market

parameter: \( Q_i^{\text{CDA}} \), \( Q_i^{\text{Call}} \)

Environmental traders ensure some flow of trade

Reinforcement learning

\( \epsilon \)-greedy pick market

ZI strategy
Equilibrium

Converged $Q_i^{\text{CDA}}, Q_i^{\text{Call}}$ for $\forall i$

Equilibrium ?

parameter space

Bayesian Optimization

Trader:

Trader

Higher profit ?
Learned BO

Proportion of orders

Proportion-go-CALL
Equilibrium

All orders in CALL, equilibrium?

It is!
Discussion

CDAs can incentivize the wrong things (latency arms race)

Frequent call markets have been proposed as a market design response (Budish et al 2015; Wah and Wellman 2013)

Two important questions:
1. Are frequent call markets socially preferable?
2. Can they effectively compete against CDAs?
• Positive evidence is accumulating on both fronts

• Budish et al (2015): No benefit to small speed advantages in frequent call markets (simple theoretical model)

• Wah et al (2015): frequent call markets can attract trade when all traders initially commit to one market (EGTA)

• Our contribution:

• Traders can dynamically choose markets. Frequent call markets:

  • are social-welfare enhancing (background traders do better)

  • can attract trade away from CDAs