

# Exploring Market Making Strategies for High Frequency Trading: an Agent-Based Approach

Yibing Xiong<sup>1</sup>, Takashi Yamada<sup>2</sup>, and Takao Terano<sup>3</sup>

<sup>1,2,3</sup>Tokyo Institute of Technology, 4259 Nagatsuta-cho, Yokohama, 226-8503 JAPAN

E-mail: <sup>1</sup>ybxiong@trn.dis.titech.ac.jp, <sup>2</sup>tyamada@trn.dis.titech.ac.jp, <sup>3</sup>terano@dis.titech.ac.jp

## Abstract

This paper utilizes agent-based simulation to explore market making strategies for high frequency traders (HFTs) in stock market. After proposing a model considering both volatility and liquidity properties of HFTs as well as stylized facts of financial market, we carry out experiments to explore optimal order price which increases profits and appropriate order size which decreases risks. As the result, we find that offering prices around temporary price, as well as along with the direction of market microstructure, earn the maximum returns for HFTs. On the other hand, our results show setting a net threshold as about 35% of the average executive order volume helps to control the risks of net position, order cancellation rate and liquidity demand. In addition, we introduce the environments of increased competitors, decreased latency and diversified strategies, so as to see how these factors affect the market making strategies.

**Keyword:** high frequency trading, agent-based modeling, market making strategies

## 1 Introduction

While High Frequency Trading (HFT) has gained much attention since the flash crash on May 6, 2010, one formidable challenge for better understanding its activities is the difficulty of obtaining useful data and identifying HFT transactions. To address this problem, we utilize agent-based model to generate an artificial stock market, obtain HFT's trading data and test their strategies.

To begin with, we combine previous work and build an intra-day transaction model based on limit order book to simulate the trading activities of HFTs and LFTs (Low Frequency Traders). While LFTs form their orders by combining fundamental-, chart-, and noise-based forecasts, HFTs submit both sell and buy orders in order to absorb the orders of LFTs and earn the profit on the spread. The statistical properties of HFT are utilized to calibrate the parameters and the stylized facts of financial market are used to validate the model.

After that, we design three experiments to study HFT order price, sub strategies and inventory size respectively. We consider intra-day returns as HFTs' profits, and their risks are represented by end-day inventories. By analyzing both passive and aggressive market making, as well as market micro-structure and order re-balance, we manage to figure out what kind of order price helps HFTs earn the best profits, and what kind of order size helps them lower the risks.

Finally, we test our strategies in competition environments, including increased competitors, de-

creased latency and diversified strategies. We first change the percentage of HFTs to see the influence on their profits and risks. In addition, we assume some HFTs always submitting their orders earlier than others, in order to see the consequence of front-running. Moreover, we allow HFTs to utilize different strategies for trading, and compare the performance of these strategies.

## References

- [1] Brogaard J. High frequency trading and its impact on market quality[J]. Northwestern University Kellogg School of Management Working Paper, 2010: 66.
- [2] Leal S J, Napoletano M, Roventini A, et al. Rock around the clock: an agent-based model of low-and high-frequency trading[J]. arXiv preprint arXiv:1402.2046, 2014.
- [3] LeBaron B, Yamamoto R. Long-memory in an order-driven market[J]. *Physica A: Statistical Mechanics and its Applications*, 2007, 383(1): 85-89.
- [4] Menkveld A J. High frequency trading and the new market makers[J]. *Journal of Financial Markets*, 2013, 16(4): 712-740.
- [5] Securities and Exchange Commission. Concept release on equity market structure[J]. *Federal Register*, 2010, 75(13): 3594-3614.