High Frequency Trading in Financial Markets: Information, Speed and Learning

Junqing Kang

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Finance Discipline Group, UTS Business School
University of Technology Sydney

Principal Supervisor: Professor *Xue-Zhong (Tony) He*
Co-supervisor: Professor *F. Douglas Foster*
Co-supervisor: Dr *Lei Shi*
Co-supervisor: Associate Professor *Jianxin Wang*

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Junqing Kang, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy (PhD), in the Finance Discipline Group, UTS Business School at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Signature: Production Note: Signature removed prior to publication.

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Abstract

This thesis consists of three essays on high frequency trading in financial markets with respect to speed acquisition, information production, and learning. Development of financial markets is largely driven by technological innovations. Starting with the computerization of tasks on trading floors, through the introduction of completely electronic markets, to Algorithmic Trading (AT) and High Frequency Trading (HFT), trading becomes much faster. Whereases financial market participants have benefited enormously from these trading transformations, we have also experienced market instabilities or failures such as market breaks and flash crashes. Economists have expressed their concern about the potentially negative effects of "excessive speed", which brings some challenging issues for market regulators. Within rational expectations equilibrium framework, this thesis examines the impact of HFT on strategic trading behaviour among interacting traders, information efficiency, and market liquidity. The findings provide some insights into the underlying economic mechanisms and policy implications under the scope of the electronic evolution of modern trading environment.

The first phenomenon investigated in this thesis is the sudden liquidity deteriorations in financial markets, such as the so-called "Flash Crash" incident. Chapter 2 proposes a nonlinear rational expectations equilibrium model of high-frequency endogenous liquidity provision to explore fragile liquidity. The risk from endogenous liquidity provision of high frequency traders (HFTs), coupled with limits to participation by designated market makers (DMMs), intensifies the adverse selection faced by DMMs. This can generate a gap between liquidity supply from DMMs and liquidity demand by informed traders. As a result, endogenous liquidity provision produces fragile liquidity, with the possibility of market breaks when HFTs switch from liquidity provision to consumption on the basis of unexpected shocks. With "circuit breaker", the presence of HFTs is more likely to triggering mandated trading halts, though market liquidity can be improved. The competition among HFTs with overlapped information can ease a

systematic liquidity withdrew simultaneously but speed up liquidity dry-up, resulting market breaking down in alarming fashion during market turmoil.

Those who take the view that fast trading can be harmful for financial markets have proposed a broad array of policies to slow down trading in financial markets, e.g., "speed bumps" on IEX or Alpha. Chapter 3 theoretically evaluates how technological innovations drive fast trading investment for both speculators and exchanges and their impact on market. The negative externality of the speed acquisition from fast speculators can result in excessive investment, which is intensified as speculators' speed technology advances. As exchange's speed technology advances, faster exchange makes faster speculators more concentrated; that is, higher exchange speed shrinks market fraction of fast speculators but stimulates their optimal trading speed. As the result, market liquidity is improved but price discovery is reduced. Policy makers aiming to balance price discovery and deadweight loss from costly speed investment may lead to a mismatch between the desired exchange speed for policy makers and the optimal speed supplied by exchange, echoing the concerns of market regulations about market failure on speed arms race.

Finally, Chapter 4 explores how the evolution in speed technologies influences information production and strategic trading among different investors and hence price discovery. Speed hierarchy not only motivates fast trading competition on less precise information but also renders slower traders more informative. As a result, endogenous speed acquisition in equilibrium affects how information is produced and spread. When information diffusion is characterized by its disclosure level (measured by initial information precision) and dissemination rate (at which heterogeneous information disperses across investors), these factors can have opposite impacts on price discovery. High disclosure leads to more informative fast trading, while fast dissemination crowds out fast traders. Channelled by strategic complementarity of late to early trading, price discovery is improved with disclosure but reduced with dissemination over the short and long run.

Overall, this thesis sheds light into the influence of the most important technological innovation, namely HFT, on liquidity evaporation, speed acquisition, and information disclosure and provides some policy implications for market regulators on HFT.

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