Journal of Financial Markets 30 (2016) 54–77

Contents lists available at ScienceDirect

Journal of Financial Markets

journal homepage: www.elsevier.com/locate/finmar

Price discovery and the cross-section of high-frequency trading ☆

Evangelos Benos [a], Satchit Sagade [b,*]

[a] Bank of England, Threadneedle Street, London EC2R 8AH, UK
[b] Department of Finance and Research Center SAFE, Goethe University, Frankfurt am Main, Germany

ARTICLE INFO

Article history:
Received 7 September 2013
Received in revised form
17 March 2016
Accepted 17 March 2016
Available online 24 March 2016

JEL classification:
G10

Keywords:
High-frequency trading
Price discovery

ABSTRACT

We quantify the price discovery contributions of high-frequency traders (HFTs) in the United Kingdom equity market and examine how it varies in their cross-section. For this, we group individual HFTs according to their liquidity taking/making activity. HFTs contribute about 14% of all trade-induced information, with aggressive HFTs accounting for two-thirds of this contribution. This suggests that HFTs who pursue strategies that require the use of aggressive trades are most informed, as opposed to passive HFTs who more likely act as market-makers. However, information shares decline with the amount of aggressive volume, suggesting that these trading strategies are not scalable.

1. Introduction

Over the past few years, high-frequency trading (HFT) activity has become prevalent in a number of securities and derivatives markets, accounting for a significant fraction of the trading volume.[1,2]

☆This is a revised version of an earlier paper titled: "High-Frequency Trading Behaviour and Its Impact on Market Quality: Evidence from the UK Equity Market." This version utilizes a significantly expanded dataset. We would like to thank Ana Fernandes and Peter Mason of the Financial Conduct Authority for being so helpful with our many questions about the ZEN database. We would also like to thank Alfonso Dufour, Simon Hargreaves, Stefan Hunt, Tim Rowe, Edwin Schooling-Latter, Erik Theissen, Michalis Vasios, Christian Westheide, Filip Žikeš, an anonymous referee, and seminar participants at the Bank of England, the Copenhagen Business School, the Norges Bank, the UK Financial Conduct Authority, and ICMA Centre for useful comments and suggestions. Satchit Sagade gratefully acknowledges research support from the Research Center SAFE, funded by the State of Hessen initiative for research LOEWE. The views expressed in this paper do not necessarily reflect those of the Bank of England or the Financial Conduct Authority.

* Corresponding author. Tel.: +49 69 798 30085.
E-mail addresses: evangelos.benos@bankofengland.co.uk (E. Benos), sagade@safe.uni-frankfurt.de (S. Sagade).

[1] We use the acronym HFT to denote both high-frequency trading and high-frequency traders.

[2] For a detailed overview of the characteristics of HFTs, see AFM (2010), SEC (2010), and Jones (2013).

http://dx.doi.org/10.1016/j.finmar.2016.03.004
1386-4181/

As a result, and following the May 6, 2010 flash crash in the United States, HFT has caught the attention of academics and policy makers worldwide.[3] Indeed, regulators on both sides of the Atlantic have implemented or are contemplating rules aimed at mitigating any potentially detrimental effects of HFT activity on market quality.[4] The debate has mainly centered around the impact of HFT on various aspects of market quality, such as liquidity and price discovery.

This paper utilizes proprietary transactions data from the equity market in the United Kingdom (U.K.), over a four-month period, to assess and quantify the impact of various types of HFT firms on price discovery and also compare and contrast their information contributions against each other and against all other market participants. Thus, in this paper we extend previous work on the subject (e.g., Brogaard, Hendershott, and Riordan, 2014 and references therein) by examining how price discovery varies in the cross-section of HFT firms.

The data we use are uniquely suited for this exercise. The data allow us to identify market participants and track the activity of individual HFT firms. Additionally, our data capture the activity of some of the largest stand-alone HFTs, in one of the world's major stock markets. Although we observe activity at the firm level, for confidentiality reasons we group HFT firms according to their overall liquidity taking/making behavior into passive, neutral, and aggressive groups and study the information contributions of each group.

We start our analysis by examining the inventory dynamics of the above groups, across the four largest lit venues in the U.K. We do this in order to see how HFTs' aggressiveness (our grouping criterion) is associated with their trading patterns. We find that over longer horizons (measured in hours), the inventories of all groups are mean-reverting and exhibit very similar patterns of serial correlation. However, over shorter horizons (measured in seconds), the various groups manage their inventories in markedly different ways. In particular, aggressive HFTs appear to be insensitive to recent (i.e., 10 second) price changes, consistent with news trading. Neutral HFTs are trend chasers (i.e., they trade in the direction of recent price changes), which is suggestive of momentum strategies. Finally, passive HFTs trade in the opposite direction of only the previous second price change, which is consistent with market-making.[5] At the same time, aggressive and passive HFTs are more sensitive to their accumulated inventory level, whereas neutral HFTs are less so and as a result they accumulate larger intra-day positions. The analysis of HFTs' inventory dynamics reveals substantial heterogeneity in trading patterns. This raises the question of how HFT firms with such different trading patterns contribute to price discovery and motivates the rest of the paper.

To examine how information contributions vary in the cross-section of HFT firms, we look at the price impact of the liquidity-taking trades of the HFT firms in each group. We focus our price discovery analysis on a single order book and for this reason we use data on trades executed on the London Stock Exchange (LSE), the largest lit venue in the U.K. by trading volume. Our LSE data capture a larger share of overall market activity than the data used previously to study HFT. This is because lit volume in the U.K. is less fragmented than in the U.S., where most other studies on HFT use data from. During our sample period and depending on the particular stock, the LSE accounted for 55–70% of the total U.K. lit volume.[6]

For our analysis, we first estimate a calendar time specification where we regress price changes on contemporaneous and lagged group-level HFT order flow. We find that the order flow of aggressive

[3] See CFTC-SEC (2010) for the official report on the Flash Crash. See Haldane (2012) and Shapiro (2012) for a regulatory perspective on HFT.

[4] For instance, as part of the revision of the Markets in Financial Instruments Directive (MiFID) in Europe, regulators will require HFT firms to provide a detailed description of the algorithms being used and to test-run these algorithms extensively before rolling them out. MiFID will also limit the ratio of submitted orders to executed trades, which is bound to affect HFT activity. (See Articles 17.2 and 48.6-9 of the MiFID document available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0065.) In the U.S., the Securities and Exchange Commission (SEC) is contemplating introduction of anti-disruptive trading rules aimed at inhibiting excess volatility that might be caused by HFT. See the relevant section of a June 5, 2014 speech by SEC Commissioner Mary Jo White, available at: https://www.sec.gov/News/Speech/Detail/Speech/1370542004312.

[5] A price increase (decrease) is likely to hit an ask (bid) quote and thus trigger a sell (buy) by a HFT present at the top of the book.

[6] Fidessa fragmentation index available at http://fragmentation.fidessa.com/fragulator/.