Available online at www.sciencedirect.com

Borsa İstanbul Review

Borsa İstanbul Review xx (2016) 1–16

http://www.elsevier.com/journals/borsa-istanbul-review/2214-8450

Full Length Article

Algorithmic and high-frequency trading in Borsa Istanbul

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Received 2 November 2015; revised 1 August 2016; accepted 5 September 2016

Available online ■ ■ ■

Abstract

This paper investigates the levels of algorithmic trading (AT) and high-frequency trading (HFT) in an emerging market, Borsa Istanbul (BIST), utilizing a dataset of 354 trading days between January 2013 and May 2014. We find an upward trend in AT by using common proxies: number of messages per minute and *algo_trad* of Hendershott et al. (2011). Mean *algo_trad* for BIST 100 index constituents varies between −18 and −13 which is parallel to 2003–2005 levels of NASDAQ large cap stocks. Initially, we measure HFT involvement by detecting linked messages as in the way proposed in Hasbrouck and Saar (2013). Next, we propose an extended HFT measure which captures various HFT strategies. This measure attributes approximately 6% of the orders to HFT. HFT involvement is higher in large orders (11.96%), in orders submitted by portfolio/fund management firms (10.40%), after improvement of BIST's order submission platform and tick size reduction for certain stocks.

JEL classification: G10; G12; G14; G23

Keywords: Algorithmic trading; High-frequency trading; Borsa Istanbul; Market microstructure

1. Introduction

Algorithmic trading (AT), which is performed by computer algorithms rather than humans, has been growing extensively with the recent technological developments. High-frequency trading (HFT) is a broad subset of AT. HFT benefits from the technological capability of sending large number of orders in low latencies of milliseconds. Computerized and automated systems are much faster than the possible speed of a human's reaction. This provides HFT algorithms with a significant comparative advantage. Recent observations in order submission patterns show the sharp increase in HFT involvement in financial markets.

Developed markets with qualified technological infrastructures and large participation, experienced HFT earlier and in larger amounts. Introduced in late 1990s, HFT is estimated to reach its peak in 2009. Grant (2010) and Haldane (2010) claim that in that year HFT accounted for 60% of the shares traded and 70% of the turnover in US equity markets while HFT involvement in Europe was around 40%. Brogaard (2010) and Brogaard, Hendershott, and Riordan (2014) study a 120 stock dataset in which NASDAQ identified the trading by 26 high-frequency firms in 2008 and 2009. They report that HFT accounts for 68.5% of dollar volume and it takes part in 74% of trades. Hendershott and Riordan (2013) utilize a similar dataset with identified algorithmic traders. They observe that AT generates 52% of market order volume and 64% of limit order volume in Deutsche Börse. Although it is estimated that HFT involvement in the US equity market has been decreasing after 2009, its share was suggested to be as high as 51% in 2012 (Popper, 2012).

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Peer review under responsibility of Borsa İstanbul Anonim Şirketi.

http://dx.doi.org/10.1016/j.bir.2016.09.005

Most of the financial markets literature assumes two main motivations for trading: information and liquidity.[1] However, HFT as a new motive for trade initiation actually dominates developed financial markets. Besides it has various consequences on the way we interpret financial environment. On one hand, ideas developed by traditional theories ignoring the existence of HFT may miss part of the truth. For example, Easley, Lopez de Prado, and O'Hara (2011, 2012) suggest that widely used informed trading measure, PIN (probability of informed trading) (Easley, Kiefer, O'Hara, & Paperman, 1996) is no longer capable of detecting informed trading due to large involvement of HFT. Consequently, they develop a new metric named VPIN (volume synchronized PIN) to measure order flow toxicity. Brennan, Huh, and Subrahmanyam (2014) show that explanatory powers of three common risk factors (size, book-to-market ratio and momentum) are significantly distorted by HFT. Chordia, Roll, and Subrahmanyam (2011) suggest that market quality and price efficiency have improved due to increased volume caused by HFT. Chordia, Subrahmanyam, and Tong (2014) further examine various market anomalies. The authors find that their economic and statistical significance have substantially decreased through the recent HFT era. On the other hand, there is a growing interest and questioning about the HFT activity by rule makers. The benefits and drawbacks of HFT are highly debated worldwide (Lewis, 2014).

We believe academic research will be more and more concentrated on HFT in the upcoming years, especially in emerging markets. Measurement of HFT and AT levels is essential in explaining stock price movements and other market characteristics. The relevant literature being very recent and incomplete, this paper is one of the first attempts to deal with this strategic topic.

In the literature, AT is usually linked to the number of total and/or canceled orders. Using 12 days of data for the Xetra system of Deutsche Börse, Prix, Loistl, and Huetl (2007) make a detailed analysis of the orders based on fulfillment. It is shown that 65% of the orders are no-fill deletion orders, i.e., orders that are fully canceled without execution. Moreover, cancellations mostly occur after several specific lifetimes, namely at 1 and 2 s, and after 0.5, 1, 2 and 3 min Hasbrouck and Saar (2009) find that 37% of the limit orders in their NASDAQ dataset are canceled within 2 s. Furthermore, these orders are priced more aggressively than orders with longer lives. On the other hand, they observe that only 6.37% of the total quantity of limit orders is satisfied. These facts are linked to the technological improvements and higher amount of market fragmentation which enhances AT opportunities.

Hendershott, Jones, and Menkveld (2011) use the number of electronic messages per $100 of trading volume as a proxy for AT. Electronic messages include all of the order submissions and cancellations. The proxy is referred as "*algo_trad*". They find that trading volume per electronic message monotonically decreases from $7000 in 2001 to around $1100 by the end of 2005. In a parallel study, Biais and Weill (2009) theoretically show that both number of canceled orders and *algo_trad* are correlated with AT.

In relevant studies, HFT is associated with the speed of order submission, the lifetime of orders and the existence of linked messages in low latencies. Hendershott and Moulton (2011) make a comparative analysis on the periods before and after the activation of NYSE's hybrid market. It is shown that the hybrid market increased automation and reduced execution times from 10 s to less than a second. Riordan and Storkenmaier (2012) examine the effects of a major upgrade in Xetra. The upgraded version of the system reduces the speed of order submission from 50 to 10 ms. Average number of quote changes at the best bid and ask is more than doubled after the upgrade. In addition, the authors propose and use QV ratio which represents the number of quote changes at the best bid or best ask per $10,000 of volume.

Hasbrouck and Saar (2013) (hereafter, HS 2013) propose a proxy for detecting HFT. This proxy is based on strategic runs of messages linked to each other. Specifically, if messages with the same size and in the same direction are observed within 100 ms, they are linked to each other. In this manner, there can be at least two separate orders and three messages (submission of a nonmarketable limit order, its cancellation and its resubmission as a marketable limit order that executes immediately) involved in a run. In order to obtain more confident representatives, the authors select a narrower set of runs with 10 or more messages. Next, they obtain a measure called "*RunsinProcess*" by time weighting the duration of each run in 10-min intervals. Consequently, they detect more than 113 million runs in the dataset that consists of 44 trading days and 350 to 400 NASDAQ stocks. 54%−60% of the cancellations are involved in strategic runs. This measure is shown to be highly correlated with HFT measures based on the trading activity of HFT firms.

Part of the literature uses special datasets which already incorporate information on documented AT or HFT activity of licensed firms.[2] On the other hand, most financial markets do not provide information on whether an order comes from an algorithmic or high-frequency trader. Then, tools for quantifying the levels of AT and HFT in financial markets are needed. Hendershott et al. (2011) AT proxy, *algo_trad* and HS (2013) HFT measure, *RunsInProcess* are among the most widely used of these tools.

HFT in developed markets has been broadly studied. The findings suggest that its share is even larger than 50%. On the other hand, there is not reliable information on the existence and extent of AT and HFT in emerging financial markets. Boehmer, Fong, and Wu (2015), using *algo_trad* (Hendershott et al., 2011), perform the broadest study on AT activity with data from 42 countries including emerging markets. However, they do not state country-specific levels of AT. Haldane (2010)

[1] See for example, broad market microstructure literature initiated by studies such as Kyle (1985), Glosten and Milgrom (1985) and Easley et al. (1996).

[2] See Brogaard et al. (2014), Menkveld (2013), Hagströmer and Norden (2013) and Carrion (2013) among others.

Please cite this article in press as: Ersan, O., & Ekinci, C., Algorithmic and high-frequency trading in Borsa Istanbul, Borsa İstanbul Review (2016), http://dx.doi.org/10.1016/j.bir.2016.09.005