Journal of Banking & Finance 59 (2015) 330–349

Contents lists available at ScienceDirect

Journal of Banking & Finance

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

High frequency trading and end-of-day price dislocation ☆

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ARTICLE INFO

Article history:
Received 25 June 2014
Accepted 11 June 2015
Available online 27 June 2015

JEL classification:
G12
G14
G18
K22

Keywords:
High frequency trading
Price dislocation
Manipulation

ABSTRACT

We show that the presence of high frequency trading (HFT) has significantly *mitigated* the frequency and severity of end-of-day price dislocation. The effect of HFT is more pronounced on days when end of day price dislocation is more likely to be the result of market manipulation. Moreover, the effect of HFT is more pronounced than the role of trading rules, surveillance, enforcement and legal conditions in curtailing the frequency and severity of end-of-day price dislocation. We show our findings are robust to different proxies of the start of HFT by trade size, cancellation of orders, and co-location.

"There is nothing so terrible as activity without insight."
Johann Wolfgang von Goethe

1. Introduction

High frequency trading (HFT) has become commonplace in many exchanges around the world. HFT involves implementing proprietary trading strategies through the use computerized algorithms. HFTs rapidly trade in and out of positions thousands of times a day without holding positions at the end of the day, and profit by competing for consistent albeit small expected profits on each trade. While estimates vary due to the difficulty in ascertaining whether each trade is an HFT, recent estimates suggest HFT accounts for 50–70% of equity trades and around 50% of the futures market in the U.S., 40% in Canada, and 35% in London (Zhang, 2010; Grant, 2011; O'Reilly, 2012; Easley et al., 2012; Scholtus et al., 2014). The growth in HFT activities has generated plenty of attention from financial market regulators and commentators,[1] particularly as HFTs were found to have contributed to the May 6, 2010 Flash Crash by withdrawing liquidity (Easley et al., 2011). Some commentators have likewise expressed concern that HFT might increase the prevalence of market manipulation (Biais and Woolley, 2011). However, prior work has not empirically examined the impact of HFT on specific forms of price manipulation, which

☆ We are indebted to the UK Government Office for Science, the Investment Industry Regulatory Organization of Canada (IIROC) and Capital Markets CRC for financial support. Douglas Cumming is also indebted to the Social Sciences and Research Humanities Council of Canada (SSHRC) for financial support. We owe special thanks to Franklin Allen, Ming Dong, Sofia Johan, Pauline Shum, and three anonymous referees from the UK Government Office for Science for helpful comments and suggestions. Sofia Johan generously gave permission to use data on surveillance from Cumming and Johan (2008). Also, we owe thanks to the seminar participants at Simon Fraser (2012), Lancaster (2012), York (Toronto) (2012), China Europe International Business School (Shanghai) (2013), Bank of Canada (2013), Concordia University (2013), Goethe University Frankfurt (2013), Financial Management Association (2013), French Finance Association (2013), Northern Finance Association (2013), American Economic Association (2013), European Finance Association (2013) and John Carroll University (2014).

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http://dx.doi.org/10.1016/j.jbankfin.2015.06.011
0378-4266/

[1] See, e.g., Huw Jones, "EU Lawmaker Turns Screws on Ultra-Fast Trading", Reuters (March 26, 2012); Lucas Mearian, "SEC Probes High-Speed Traders," Compterworld (March 26, 2012); Chlistalla (2011). Commentators indicated recently that "[l]eading fund managers are calling for greater regulation of high frequency trading which they warn is resulting in market manipulation"; see Financial Review, August 15 2102, http://afr.com/p/business/companies/crack_down_on_high_frequency_trading_CSA9PgK9WGQJp9sgngTF7K. FINRA even asked high frequency trading firms to disclose computer codes in order to check for manipulative strategies; see http://www.reuters.com/article/2011/09/01/us-financial-regulation-algos-idUSTRE7806J420110901.

is arguably an important area of concern (Comerton-Forde and Putnins, 2014; Putnins, 2012; Yi and Gencay, 2012; Lewis, 2014).

In this paper, we directly examine the link between HFT and one very important and specific form of manipulation: end-of-day price dislocation. 'Closing' or 'end-of-day' [hereafter EOD] prices are extremely important for a number of reasons, including the fact that they are often used to determine the expiration value of derivative instruments and directors' options, price of seasoned equity issues, evaluate broker performance, compute net asset values of mutual funds, and compute stock indices (Comerton-Forde and Putnins, 2011).[2] As such, some traders have an incentive to manipulate closing price by ramping up end of day trading to push the closing price to an artificial level.

Specifically, we examine closing price dislocation from 22 stock exchanges around the world from January 2003–June 2011. We construct a monthly panel dataset of the frequency and severity of EOD price dislocation cases. Suspected cases on EOD price dislocation are based on consideration of a significant increase in the EOD returns, trading activity in the last part of the day, and bid-ask spreads, as well as a reversion to natural price level the following morning (Carhart et al., 2002; Hillion and Suominen, 2004; Comerton-Forde and Putnins, 2011; Branch and Evans, 2011). These EOD price dislocation cases considered herein were in fact developed with market surveillance authorities and their software developers for the respective countries, including Capital Markets CRC, and SMARTS, Inc.

We relate the frequency and severity of EOD price dislocation across markets and over time to the introduction of high-frequency trading. The actual start date of HFT, if at all, is not known with precise accuracy across all markets around the world. Nevertheless, HFT is usually characterized by large number of orders with smaller order quantities, speedy cancellations, and tending to have short position-holding periods with almost no overnight position (Aldridge, 2009; Brogaard, 2010; Gomber et al., 2011; Henrikson, 2011). To this end, we examine when unusual changes in market trading patterns occurred over the January 2003–June 2011 to identify when, if at all, HFT was likely having a significant influence in the marketplace. Moreover, we consider other factors such as whether or not the exchange has direct market access (DMA), which is a requirement for HFT. We examine the robustness of our findings to different proxies in order to identify the material presence of HFT in a marketplace, including trade size, cancellation of orders, and co-location (see the Appendix).

The data examined in this paper show that marketplaces with a significant presence of HFT are substantially less likely to experience EOD price dislocation and more severe EOD price dislocation. In particular, the number of suspected EOD price dislocation cases decrease by 7.64 cases per month in the most conservative estimate; given the average number of cases per month in the data is 36.56, this means that HFT decreases the probability of EOD dislocation by 20.90%. This effect is statistically significant regardless of the empirical methods and control variables. Moreover, HFT is associated with a decrease in the total trading value surrounding per suspected dislocating the EOD price case (the number of shares traded multiplied by the corresponding dislocated price) by the most conservative estimate of 41.09% relative to the average size of the total trading value surrounding per suspected dislocating the EOD price case; the least conservative estimate is 64.71%.

Interestingly, on days when end of day dislocation is more likely to be attributable to manipulation, the correlation between HFT and EOD dislocation is even more pronounced. At the end of month and on days when options expire, HFT is associated with a fall in the number of cases by 72–80%, (while the economic significance of HFT on the reduction on average trading values is analogous to the other days).

Note that policy mechanisms, including trading rules, surveillance and enforcement, appear to have had less of an effect in mitigating EOD price dislocation. This is surprising, since these mechanisms have been shown to improve market quality in terms of increased liquidity, lower bid–ask spreads, improved market capitalization and greater numbers IPOs (Aitken and Siow, 2003; La Porta et al., 2006; Cumming and Johan, 2008; Jackson and Roe, 2009; Cumming et al., 2011). By contrast, HFT is prevalent only on the most liquid exchanges around the world, and yet policy mechanisms have had less of an effect in curtailing the positive outcomes of HFT in terms of less pronounced and less frequent EOD price dislocation.

Our paper is related to a small but growing literature on HFT. The benefits and costs of HFT are nicely summarized by Biais and Woolley (2011). Potential benefits of HFT include: (1) HFT can help ensure that related assets remain consistently priced due to increased liquidity (Chaboud et al., 2009); (2) HFT algorithms can help traders cope with market fragmentation by fostering competition between trading mechanisms, including exchanges and other platforms; and (3) HFT algorithms can mitigate traders' cognition limits and traders' limited rationality. Brogaard (2010) found that the participation rate of HFT in the sample NASDAQ equity trading data used in his study is approximately 75% and he concluded that HFT play a vital role in the price efficiency and price discovery process. Hendershott and Riordan (2010) and Hendershott et al. (2011) find consistent evidence from NASDAQ on the important role of HFT in price discovery and liquidity.

Biais and Woolley (2011) also note that potential costs of HFT include: (1) manipulation in various ways that are described in Section 2 below; (2) adverse selection in the sense that non-HFT trades are slower and less well informed than HFT trades, thereby leading to a reduced market participation among non-HFT traders (i.e., HFT trades impose a negative externality of adverse selection on non-HFT traders); (3) imperfect competition among HFT traders and non-HFT traders due to the large fixed costs of establishing HFTs; and (4) systematic risk, which might increase if HFT algorithms rely on similar strategies which are correlated. In respect of the first point, we are not aware of any systematic evidence on the effect of HFT on market manipulation. In respect of the latter point, the evidence on the impact of HFT on volatility is mixed depending on the context. Focused on the recent Flash Crash in the United States financial market that occurred on May 6th, 2010, Kirilenko et al. (2011) argue that High-frequency traders (HFTs) did not activate the Flash Crash but rather intensified the market volatility. However, Brogaard (2010) finds that, rather than increasing stock volatility due to more frequent trading, HFT reduces stock volatility.

Our paper does not weight-in on each of these specific benefits or costs, but rather focuses on the narrow question of whether or not HFT affects the frequency and magnitude of EOD price dislocation. Overall, our findings are suggestive that HFT increases the difficulty of market manipulators manipulating EOD closing prices. Our central finding is therefore consistent with the extant evidence and results in Brogaard (2010), Hendershott and Riordan (2010) and Hendershott et al. (2011) on the valuable role for HFT in facilitating price discovery. Our findings do not imply that HFT impacts the difficulty of manipulating prices or volume in other ways. Those issues are beyond the scope of our paper. Perhaps future efforts in monitoring HFT are warranted among policymakers and surveillance authorities, but such efforts should not inhibit the role of HFT in facilitating a reduction in EOD price dislocation.

This paper is organized as follows. Section 2 discusses EOD price dislocation in relation to HFT as well as various policy mechanisms designed to curb price dislocation. Section 3 introduces the data

[2] For related work on market manipulation and exchange governance, see Aggarwal and Wu (2006), Allen and Gale (1992), Allen and Gorton (1992), Carhart et al. (2002), Comerton-Forde and Rydge (2006), Merrick et al. (2005), O'Hara (2001), O'Hara and Mendiola (2003), Peng and Röell (2009), Pirrong (1999, 2004), and Röell (1992).