



# The diversity of high-frequency traders<sup>☆</sup>

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## Abstract

The regulatory debate concerning high-frequency trading (HFT) emphasizes the importance of distinguishing different HFT strategies and their influence on market quality. Using data from NASDAQ-OMX Stockholm, we compare market-making HFTs to opportunistic HFTs. We find that market makers constitute the lion's share of HFT trading volume (63–72%) and limit order traffic (81–86%). Furthermore, market makers have higher order-to-trade ratios and lower latency than opportunistic HFTs. In a natural experiment based on tick size changes, we find that the activity of market-making HFTs mitigates intraday price volatility.

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## 1. Introduction

Recent advances in information technology employed in equity markets allow traders to process information and submit orders at lightning speed. With typical holding periods measured in seconds or even fractions of seconds, resulting in large trading volumes, algorithmic strategies are now major forces in equity markets. Since the arrival of such strategies has coincided with

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massively increased limit order submissions and cancellations, high intraday price volatility (including flash crashes), and fragmentation of volumes across marketplaces, many voices have been raised, calling for the regulation of algorithmic trading (AT).

To understand the influence of AT on the quality of markets, it is important to realize that investors use algorithms for many different reasons and strategies. The mere fact that a strategy is algorithmic or based on fast trading does not determine its market impact. To distinguish the main strategies and their individual market impacts is thus pivotal for effective regulatory design. A useful distinction to make is to separate agency algorithms from proprietary algorithms. The former is typically a service provided to clients to minimize the price impact of trading. Proprietary algorithms, on the other hand, are used by technologically sophisticated firms aiming to profit from the trading process itself. Firms using proprietary algorithms are referred to as high-frequency traders (HFTs).<sup>1</sup> HFT strategies may be further subdivided into market-making strategies, on the one hand, and opportunistic trading such as arbitrage and directional (order anticipation and momentum ignition) trading, on the other (SEC, 2010).

As limit order book markets in general preserve trader anonymity, empirical analysis of distinct AT and HFT strategies is difficult. Academic research in this field is based on market-wide proxies of algorithmic activities (e.g., Hendershott, Jones, and Menkveld, 2011; Boehmer, Fong, and Wu, 2012) or proprietary data sets (e.g., Hirschey, 2013; Kirilenko, Kyle, Samadi, Tuzun, 2011; Brogaard, Hendershott, and Riordan, 2012). None of these papers has been able to distinguish different HFT strategies in equity markets.

In this paper, we use a proprietary data set that allows us to observe all limit order submissions, cancellations, and executions, complete with the identities of the traders.<sup>2</sup> Our sample includes 30 Swedish large-cap stocks traded on the NASDAQ-OMX Stockholm exchange (henceforth NOMX-St). A key contribution of our paper is that, by using detailed trading and quoting information, we are able to subcategorize HFTs into market-making strategies and opportunistic (e.g., arbitrage and directional) strategies. Our categorization methodology, combined with rich order book information, allows us to conduct a more detailed analysis of HFT in equity markets than previous studies managed. We carry out the analysis for one highly volatile month (August, 2011) and one relatively calm month (February, 2012).

We define market-making HFTs as proprietary-only firms that use algorithms in their order submission, and that have a continuous presence at the best bid and offer prices in the limit order book. We find that, within the group of HFTs, such market makers represent around 71.5% of the trading volume in August 2011, and 62.8% in February 2012. During both months, more than 80% of the HFT limit order submissions originate from the market-making strategies. The market-making HFTs in our study conform to the market makers described by Jovanovic and Menkveld (2012) and Menkveld (in this issue), in that they trade large volumes but keep inventories close to zero, and in that they are on the passive side in a majority of their trades. The result that is new to the literature is that market-making HFTs have higher order-to-trade ratios and lower latency than opportunistic HFTs. This reflects modern market making, where anyone who is unable to respond immediately to news about fundamentals or the order flow, by modifying posted orders, will be picked off by competitors.

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<sup>1</sup>We use HFT as an acronym for both high-frequency trader and high-frequency trading.

<sup>2</sup>The results of this paper are aggregated and do not reveal specific trader strategies. Furthermore, the data showing trader identities was never removed from NASDAQ OMX's possession. All trader-specific analysis was performed on site.

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