



Low-latency trading[☆]

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Abstract

We define low-latency activity as strategies that respond to market events in the millisecond environment, the hallmark of proprietary trading by high-frequency traders though it could include other algorithmic activity as well. We propose a new measure of low-latency activity to investigate the impact of high-frequency trading on the market environment. Our measure is highly correlated with NASDAQ-constructed estimates of high-frequency trading, but it can be computed from widely-available message data. We use this measure to study how low-latency activity affects market quality both during normal market conditions and during a period of declining prices and heightened economic uncertainty. Our analysis suggests that increased low-latency activity improves traditional market quality measures—decreasing spreads,

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increasing displayed depth in the limit order book, and lowering short-term volatility. Our findings suggest that given the current market structure for U.S. equities, increased low-latency activity need not work to the detriment of long-term investors.

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1. Introduction

Our financial environment is characterized by an ever increasing pace of both information gathering and the actions prompted by this information. Speed in absolute terms is important to traders due to the inherent fundamental volatility of financial securities. Relative speed, in the sense of being faster than other traders, is also very important because it can create profit opportunities by enabling a prompt response to news or market activity. This latter consideration appears to drive an arms race where traders employ cutting-edge technology and locate computers in close proximity to the trading venue in order to reduce the latency of their orders and gain an advantage. As a result, today's markets experience intense activity in the "millisecond environment," where computer algorithms respond to each other at a pace 100 times faster than it would take for a human trader to blink.

While there are many definitions for the term "latency," we view it as the time it takes to learn about an event (e.g., a change in the bid), generate a response, and have the exchange act on the response. Exchanges have been investing heavily in upgrading their systems to reduce the time it takes to send information to customers, as well as to accept and handle customers' orders. They have also begun to offer traders the ability to co-locate the traders' computer systems in close proximity to theirs, thereby reducing transmission times to under a millisecond (a thousandth of a second). As traders have also invested in the technology to process information faster, the entire event/analysis/action cycle has been reduced for some traders to a couple of milliseconds.

The beneficiaries from this massive investment in technology appear to be a new breed of high-frequency traders who implement low-latency strategies, which we define as strategies that respond to market events in the millisecond environment. These traders now generate most message activity in financial markets and according to some accounts also take part in the majority of the trades.² While it appears that intermediated trading is on the rise [with these low-latency traders serving as the intermediaries, e.g., [Menkveld \(in this issue\)](#)], it is unclear whether intense low-latency activity harms or helps the market.

Our goal in this paper is to examine the influence of these low-latency traders on certain dimensions of market quality. More specifically, we would like to know how their combined activity affects attributes such as bid-ask spreads, the total price impact of trades, depth in the limit order book, and the short-term volatility of stocks.³ To investigate these questions, we utilize publicly-available NASDAQ order-level data that are identical to those supplied to subscribers and provide real-time information about orders and executions on NASDAQ. Each

²See, for example, the discussion of high-frequency traders in the SEC's Concept Release on Equity Market Structure (2010).

³Another dimension of market quality, the informational efficiency of prices (or price discovery), and its relationship to high-frequency trading is investigated in [Brogaard, Hendershott, and Riordan \(2012\)](#), and [Carrion \(in this issue\)](#).

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