



# Speed, algorithmic trading, and market quality around macroeconomic news announcements



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## ABSTRACT

This paper documents that speed is crucially important for high-frequency trading strategies based on U.S. macroeconomic news releases. Using order-level data on the highly liquid S&P 500 ETF traded on NASDAQ from January 6, 2009 to December 12, 2011, we find that a delay of 300 ms or more significantly reduces returns of news-based trading strategies. This reduction is greater for high impact news and on days with high volatility. In addition, we assess the effect of algorithmic trading on market quality around macroeconomic news. In the minute following a macroeconomic news arrival, algorithmic activity increases trading volume and depth at the best quotes, but also increases volatility and leads to a drop in overall depth. Quoted half-spreads decrease (increase) when we measure algorithmic trading over the full (top of the) order book.

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## 1. Introduction

News arrivals are a driving force behind asset price changes. In the early days of organized exchange-based trading a telex and telephone, combined with good analytical skills, were enough for a competitive edge. More recently, a basic internet connection would suffice. Nowadays, trades based on a news feed arrive to the market before any human trader can even glance at the news. How is this possible? First, in today's markets about two-thirds of all (NASDAQ) dollar volume traded can be attributed to fully automated, high-frequency trading (Brogaard, 2010). Second, the current round-trip latency for these high-frequency traders (in case of co-location) is less than 100  $\mu$ s.<sup>1</sup> Combine this with an ultra-low latency (machine readable) news feed and it is clear that no human is able to compete purely based on speed.

It is not surprising that computers outperform humans in terms of speed. What is more interesting is that, within the universe of high-frequency traders, large differences exist in trading speed that have a substantial day-to-day impact on performance. Hasbrouck and Saar (2013) and Scholtus and van Dijk (2012) document the speed differences for interval-based high-frequency traders. They

find that the fastest traders act within five milliseconds (ms), whereas other relatively fast traders can be identified at speed levels of 50 ms and 150 ms. Scholtus and van Dijk (2012) further find that trading speed significantly affects technical trading rule performance when traders are more than 200 ms slower compared with instantaneous execution.

This paper makes two important contributions to the literature on high-frequency trading. The first and main contribution is the examination of the importance of speed for event-based trading profitability around scheduled U.S. macroeconomic news announcements with millisecond precision. High precision is especially important around these news releases, because (1) the fastest (electronic) traders need just a few milliseconds to act, and (2) the increase in order aggressiveness around macroeconomic announcements (Erenburg and Lasser, 2009) makes every millisecond count. Second, we analyze the effect of algorithmic trading activity on market quality during periods with macroeconomic news arrivals.

We investigate the importance of speed for the profitability of strategies that trade on news releases of 20 different U.S. macroeconomic variables by using the highly liquid State Street SPDR S&P 500 Exchange Traded Fund (ETF) traded on NASDAQ.<sup>2</sup> The

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<sup>1</sup> <http://www.nasdaqtrader.com/Trader.aspx?id=colo>.

<sup>2</sup> This ETF is well known by its ticker symbol SPY and is frequently referred to as 'Spider'.

period under consideration is January 6, 2009 to December 12, 2011. The exact millisecond the news becomes available to the market is obtained from the SIRCA Global News Database. We consider trading strategies with different degrees of success, defined in terms of their ability to correctly predict the direction of change in the S&P 500 index during the first minute after the news release. We measure the importance of speed by comparing the performance of a particular strategy when signals are executed instantaneously with its performance when signal executions are delayed by a certain amount of time.

We find that trading speed is very important around macroeconomic news announcements, both in economic and statistical terms. For success ratios of 60% and higher, any delay from 10 ms to 1 second leads to a statistically significant decrease in performance. The economic significance of speed increases with the degree of success with which the trade direction is predicted. Traders that can predict the correct trade direction for 70% of the news announcements lose about 0.33 (0.62) basis points (bps) per event when trades are delayed by 300 ms (1 second) compared with instantaneous execution. The corresponding loss per year is 0.80% for a 300 ms delay and 1.48% for a delay of 1 second. A trader with a success rate of 100% incurs a loss of 0.81 (1.62) bps per event, or 1.94% (3.90%) per year from a delay of 300 ms (1 second). In relative terms (with respect to the total return of a strategy), the losses due to delays by 300 ms or 1 second for a strategy with a success ratio of 70% are 10.85% and 20.05%, respectively. This is substantially higher than the 2.03% relative decline in performance when the execution of interval-based technical trading strategies is delayed by 1 second (Scholtus and van Dijk, 2012). The impact of speed on returns is higher for announcements at 10:00 a.m., on days with high volatility, and for high impact news.

The impact of algorithmic trading on market quality during macroeconomic news arrivals is analyzed by examining the behavior of spreads, order book depth, trading volume, and realized volatility measures. These indicators of market quality are related to algorithmic trading proxies such as message activity and several types of fleeting orders.<sup>3</sup> We find that periods around macroeconomic news releases are characterized by large (quoted) spreads, increased volatility, decreased depth, and increased algorithmic trading activity. Using regression analysis, we find that the effect of algorithmic trading activity on market quality immediately following macroeconomic news announcements depends on the event window and on the type of algorithm that is active. In the first minute following the news release, an increase in algorithmic trading activity measured over the full order book has a mixed effect on depth, increases trading volume and volatility, and decreases the quoted half-spread. Increased algorithmic trading activity at the top of the order book lead to wider quoted half-spreads. When we consider the 5 min following the event, increases in algorithmic trading in the full order book no longer affect trading volume and lead to a decrease in volatility, whereas more algorithmic activity at the top of the order book increases both volatility and trading volume. A possible explanation for the different effects on market quality, depending on whether we measure algorithmic trading activity over the full order book or in the top of the order book, is that these proxies measure different algorithmic trading strategies employed by different market participants.

This paper relates to the rapidly growing literature on high-frequency trading, algorithmic trading, and the effect of high speed trading on market quality, including Erenburg and Lasser (2009),

Hasbrouck and Saar (2013), Hendershott et al. (2011), Brogaard (2012), and Jiang et al. (2012).<sup>4</sup> Erenburg and Lasser (2009) find that the minutes surrounding macroeconomic news are characterized by higher volatility, wider spreads, more aggressive order submissions, and reduced depth of the order book. Hasbrouck and Saar (2013) conclude that increases in high-frequency activity improve market quality measures such as intraday volatility, quoted spread, and depth, throughout the trading day. The results of Hasbrouck and Saar (2013) for spreads are confirmed by Hendershott et al. (2011), while Brogaard (2012) corroborates their findings for intraday volatility and depth. In addition, Brogaard (2012) finds an increase in high-frequency activity within 10 seconds of a macroeconomic news release for 200 individual stocks traded on NASDAQ. Most of the increase in algorithmic activity is of a liquidity consuming nature. We extend these papers by focusing specifically on the effects of algorithmic trading on market quality during periods with macroeconomic news. In a complimentary paper, Jiang et al. (2012) investigate the role and effect of high-frequency trading in the U.S. Treasury market around macroeconomic news announcements. Their findings suggest that high-frequency trading leads to a wider spread and an increase in volatility and overall order book depth around macroeconomic news. However, the secondary market for U.S. Treasuries is considerably different from U.S. equity markets as trading in this multiple dealer, over the counter, market takes place around the clock during the week (Fleming and Remolona, 1999). Furthermore, the use of algorithmic trading is more prevalent on NASDAQ, where high-frequency traders participate in 68.5% of the dollar volume traded during 2008–2009 (Brogaard, 2010). For U.S. Treasuries on the BrokerTec platform 45% of overall trading volume can be attributed to algorithm based trading in 2009.<sup>5</sup>

The literature on the effects of macroeconomic news announcements on financial markets is large. Whereas most early work finds that (surprises in) monetary news have an impact on stock market returns (Pearce and Roley, 1985; Hardouvelis, 1987), the evidence with respect to real variables, such as industrial production, is mixed (compare Jain, 1988 with Pearce and Roley, 1985). However, when accounting for the state of the economy (McQueen and Roley, 1993; Boyd et al., 2005), looking at sufficiently small intraday intervals (Adams et al., 2004; Andersen et al., 2007), or including additional information from news headlines (Birz and Lott, 2011), the stock market shows significant price reactions to real macroeconomic news. Macroeconomic news not only affects stock prices, but also, equity volatility (Andersen et al., 2007) and intraday price jumps (Evans, 2011). We extend this literature by documenting the impact of macroeconomic news announcements on returns and volatility over small intervals following the announcement while accounting for the impact of algorithmic traders.

The outline of this paper is as follows. Section 2 provides an overview of the S&P 500 ETF and U.S. macroeconomic news announcement data. Methods concerning measures of market quality, algorithmic activity, and the importance of speed are provided in Section 3. The results in Section 4 are followed by concluding remarks in Section 5.

## 2. Data

### 2.1. Order book

We use full order book information for the State Street S&P 500 Exchange Traded Fund (ETF) traded on NASDAQ over the period

<sup>4</sup> For a more complete list on papers related to high-frequency and algorithmic trading see the literature overview provided in Gomber et al. (2011).

<sup>5</sup> See "Algos Take Hold in Fixed-Income Markets", *Securities Technology Monitor*, February 8, 2010.

<sup>3</sup> A fleeting order (Hasbrouck and Saar, 2009) is defined as an order added and removed from the order book within a short period of time, typically 50 or 100 ms.

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