Intraday periodicity in algorithmic trading

John Paul Broussard[*], Andrei Nikiforov[1]

Rutgers School of Business, Camden, 227 Penn Street, Camden, NJ 08102, United States

A B S T R A C T

This paper documents a stark periodicity in intraday volume and in the number of trades. We find activity in both variables spikes by about 20% at regular intervals of 5 or 10 min throughout the trading day. We speculate this activity is either the result of algorithmic trading influenced by human traders/programmers' behavioral bias to transact on round time marks, or the result of optimizing algorithms choosing to concentrate their trades in time to take advantage of lower costs. We find evidence supporting the former, not the latter. Measures of transaction costs show no significant change during these spikes. Amihud's measure of price impact also shows no discernable pattern. Additional research is needed to more carefully explain this recurring phenomenon.

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1. Introduction

In this paper we document pervasive periodicity in intraday trades and volume. We show that an unusually large percentage of trades is completed within just 30 s after the end of a "round" time interval such as 9:45 AM or 10:00 AM. We show that throughout the trading day, both the number of trades and the trading volume spike sharply every 5 or 10 min only to return to normal levels 30 s later (see Fig. 1). We investigate this phenomenon and speculate that the observed phenomenon is either a representation of humans' tendency toward round numbers, or trading algorithms' attempts to capture the benefits of increased liquidity and or reduced transaction costs during these short-lived

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* Corresponding author. Tel.: +1 856 225 6647.
  E-mail address: john.broussard@rutgers.edu (J.P. Broussard).
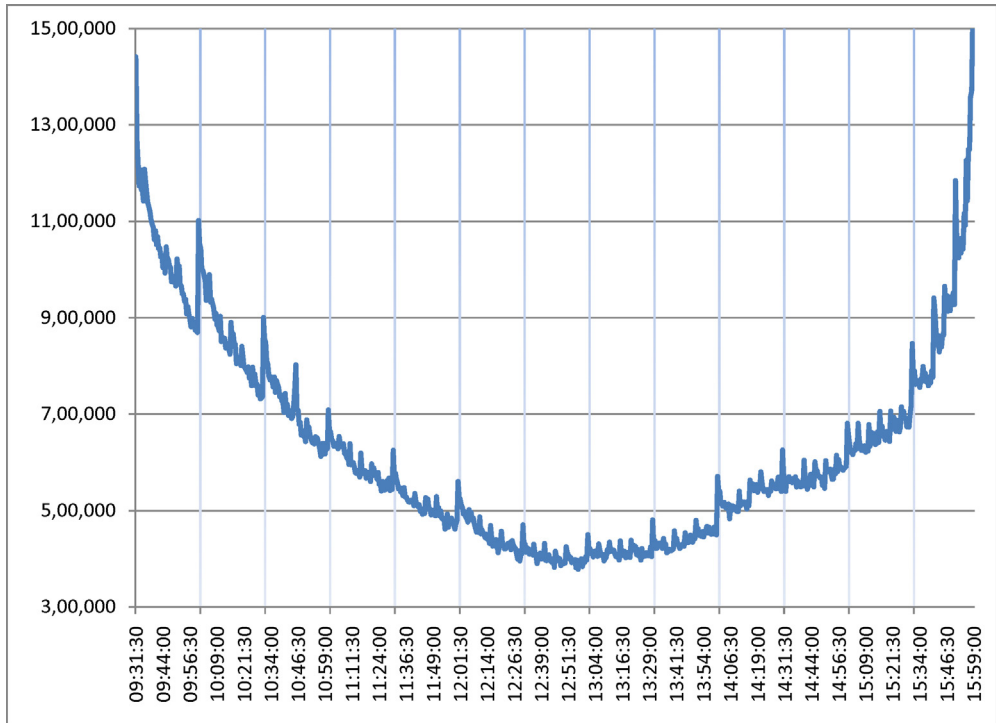[1] Tel.: +1 856 225 6594.

Fig. 1. Intraday periodicity in volume traded over 30 s intervals. The figure shows intraday periodicity in trading volume throughout the trading day. The volume in shares traded is calculated for 30 s intervals and averaged across all 39 securities and all trading days. The vertical gridlines separate the half hours starting from 9:30 AM.

spikes. Preliminary evidence indicates support for the former, but not the latter. Additional work is required to more thoroughly explain the repetitive pattern.

Various periodical patterns in stock characteristics have been documented in the literature. The focus has mainly been on periodicity in returns of different scales: from the very long term (De Bondt and Thaler, 1985, 1987), to the medium term (Jegadeesh, 1990; Jegadeesh and Titman, 1993, 2001), to the relatively short-term such as weekly and daily (Gibbons and Hess, 1981), to intraday (Heston et al., 2010). We report a completely new phenomenon: sharp spikes in trading activity on 5 min time marks within a trading day. The purpose of this paper is two-fold: (1) to document this stark periodicity, and (2) to propose and preliminarily investigate two plausible hypotheses that could generate the observed patterns.

We propose that the observed phenomenon is most likely associated with human nature's tendency to use round numbers when faced with decisions in an unstructured and uncertain environment (e.g. Loomes (1988); Booth et al., 2000; Ikenberry and Weston, 2008 among others). We hypothesize that buy-side institutional traders faced with a decision to space the execution of orders throughout the trading day, will tend to pick round numbers and intervals for when the trade should be executed. Even if the execution is implemented through a trading algorithm that breaks down a large order into smaller ones, the default settings for the timing of the smaller trades are set by programmers, and are thus subject to the same "round – number-preference" bias exhibited by all humans. Alternatively, short bursts of clustered trading activity (within 30-s time buckets) every 5 min are the outcomes of a semi-spontaneous market coordination game where the players, or traders represented by optimizing algorithms, come to trade every 5 or 10 min because these are the time periods with the highest liquidity and lowest trading costs (Admati and Pfleiderer, 1988). Hopefully, interest is generated that will invoke additional efforts that may help explain this pervasive pattern.