

# Bibliometric Analysis of Emerging Trends in High Frequency Trading Research

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**Abstract** This study reviews and demonstrates the diverse issues and findings in the research field of high frequency trading. This diversity may root from the emerging nature of computing technology and its wide appeal as well as unique researcher and practitioner viewpoints. The authors propose Bibliometric Analysis might be used to identify some fruitful research opportunities.

## 1 Introduction

As the stock market has become nearly exclusively electronic, advances in computer technology and automated algorithm trading have speeding the transmission and execution of security transaction orders, and establishing High Frequency Trading (HFT). History of HFT can be traced back at least since 1998, after the U.S. Securities and Exchange Commission (SEC) adopted Regulation ATS (Alternative Trading Systems), including electronic exchanges. After that, SEC's Regulation NMS (National Market System), which was adopted in 2005, further provided strong incentives for trading venues to automate, especially the NYSE, which was the last

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major floor-based exchange in the U.S. Until 2010, SEC issued a Concept release [1] seeking public comments on issues such as HFT. SEC admitted, “The term (HFT) is relatively new and is not yet clearly defined”.

HFT was not a well-known topic outside the financial sector, until an article [2] published by the New York Times in July 2009 which was one of the first to bring the subject to the public’s attention. HFT has radically changed the stock markets. Some view the Flash Crash of May 6, 2010 as evidence of the potential harmful effects of HFT. Michael Lewis’s recent book in 2014, *FLASH BOYS*, even raised the controversy concerning about HFT by pointing out that electronic trading has rigged the market against ordinary investors, particularly in America, but Lewis paid little attention to the market benefits of HFT. The development of HFT has ignited a heated debate among participants, researchers and regulators about the benefits and concerns related to HFT.

## 2 Diverse Issues of HFT Research

Since history of HFT is not so long, the researches in this area are highly diverse regarding issues for this new research agenda. According to a recent review article by editor Goldstein [3], unlike established topics in finance, such as dividend policy, capital structure, or asset pricing, HFT is a new, emerging, and rapidly evolving area for the markets, regulators, and the public.

In more recent years, many attempts have been made to research HFT by a number of scholars. Goldstein et al. [4] reviewed the works in this area from the empirical and theoretical papers and assigned them into following six categories on the basis of different topics: market performance [5–15], strategies and practices [16–18], evolution [11, 17, 19, 20], speed [14, 18, 21–23], fairness [1, 24, 25], regulatory implications [26, 27].

Table 1 summarizes findings by topics about each category which include the current state, topics of debate, and empirical and theoretical researches in HFT.

## 3 Bibliometric Analysis

While there are plenty of findings by topics shown by Table 1 which include the topics of debate, controversial issues, and the current arguments against HFT, however, those findings about HFT are largely qualitative in nature. Based on previous research, merely depending on review articles cannot completely reveal the developmental trends or future orientation of a new research field. Despite the high growth rate of publications, there have been few attempts to gather systematic data on the global scientific production of research on HFT.

A quantitative research tool to fill this gap is the bibliometric method, which has already been widely applied in many disciplines of science and engineering

**Table 1** Research categories and findings in HFT

| Category                   | Authors  | Findings by topic  |
|----------------------------|--|--|
| • Market performance       | • Budish et al. [5] and Menkveld [6] and Schwartz and Wu [7] | <ul style="list-style-type: none"> <li>• Adverse selection                             <ul style="list-style-type: none"> <li>– HFT’s “socially wasteful arms race” could disadvantage other ordinary investors and then reduce market quality, as measured by liquidity and price informativeness</li> </ul> </li> </ul>  |
|                            | • Jarnecic and Snape [8]                                     | <ul style="list-style-type: none"> <li>• Liquidity                             <ul style="list-style-type: none"> <li>– If HFT activity can improve the liquidity of markets?</li> </ul> </li> </ul>   |
|                            | • Brogaard et al. [9] and Hendershott and Riordan [10]       | <ul style="list-style-type: none"> <li>• Market structure                             <ul style="list-style-type: none"> <li>– Market structure changes due to the incremental effect of algorithmic trading and HFT</li> </ul> </li> </ul>  |
|                            | • Popper [11]  | <ul style="list-style-type: none"> <li>• Transaction costs                             <ul style="list-style-type: none"> <li>– As the recent volume of HFT has decreased, the benefits of HFT in reducing trading costs for ordinary investors have stalled</li> </ul> </li> </ul>  |
|                            | • Baron et al. [12]  | <ul style="list-style-type: none"> <li>• Profitability (of HFT vs. non-HFT)                             <ul style="list-style-type: none"> <li>– HFT profits are earned at the expense of other traders</li> <li>– HFT markets are effectively a “zero sum game”</li> </ul> </li> </ul>  |
|                            | • Jones [13]   | <ul style="list-style-type: none"> <li>• Volatility                             <ul style="list-style-type: none"> <li>– After surveying 30 theoretical and empirical papers on the topic of HFT, Jones [13] concludes that HFTs are making markets better</li> </ul> </li> </ul>  |
|                            | • Hasbrouck and Saar [14]                                    | <ul style="list-style-type: none"> <li>– The impact of HFT on market quality and volatility</li> </ul>   |
|                            |  | • Credit Suisse [15]   |
| • Strategies and practices | • Aldridge [16]  | <ul style="list-style-type: none"> <li>• Market efficiency</li> </ul>  |
|                            |  | <ul style="list-style-type: none"> <li>• Algorithmic strategies                             <ul style="list-style-type: none"> <li>– Statistical arbitrage strategies</li> <li>– Directional trading around events</li> <li>– Automated market making</li> <li>– Modeling information in order flow</li> <li>– Latency arbitrage</li> <li>– Spread scalping</li> <li>– Rebate capture</li> <li>– Quote matching</li> <li>– Layering</li> </ul> </li> <li>• Market manipulation                             <ul style="list-style-type: none"> <li>– Pinging/sniping/sniffing/phishing</li> <li>– Quote stuffing</li> </ul> </li> </ul> |

(continued)

**Table 1** (continued)

| Category    | Authors   | Findings by topic   |
|-------------|---|---|
|             |   | <ul style="list-style-type: none"> <li>– Spoofing</li> <li>– Pump-and-dump</li> <li>– Ignition</li> </ul>   |
|             | • Kirilenko and Lo [17]                                 | <ul style="list-style-type: none"> <li>• Manipulative trading activities                             <ul style="list-style-type: none"> <li>– ‘Order anticipation’ trading strategy (e.g. a “pinging” tactic to discover the price other traders are willing to pay or to discover undisplayed liquidity)</li> </ul> </li> </ul>  |
|             | • Laughlin et al. [18]                                  | <ul style="list-style-type: none"> <li>• Low-latency strategies                             <ul style="list-style-type: none"> <li>– Many HFT firms are concerned about transmission speed across geographic distances and utilize strategies that capitalize on their geographic location</li> </ul> </li> <li>• Co-location                             <ul style="list-style-type: none"> <li>– The ability to access direct data feeds from exchanges which includes sophisticated order execution algorithms services</li> </ul> </li> </ul> |
| • Evolution | • Rubenstein [19]                                       | <ul style="list-style-type: none"> <li>• Trading volume                             <ul style="list-style-type: none"> <li>– HFT now accounts for almost 50 % of daily stock trades</li> </ul> </li> </ul>  |
|             | • Goldstein et al. [20] and Kirilenko and Lo [17]       | <ul style="list-style-type: none"> <li>• Trading activity                             <ul style="list-style-type: none"> <li>– HFT accounted for between 40 % and 60 % of trading activity across all U.S. financial markets for stocks, options and currencies</li> </ul> </li> </ul>  |
|             | • Popper [11]   | <ul style="list-style-type: none"> <li>• Volumes and profits downtrend in US                             <ul style="list-style-type: none"> <li>– HFT volume down from 61 % in 2009 to 51 % in 2012</li> <li>– HFT profits were estimated at most \$1.25B in 2012, down 35 % from 2011 and 74 % lower than the peak of about \$4.9B in 2009</li> </ul> </li> </ul>  |
| • Speed     | • Angel [21]  | <ul style="list-style-type: none"> <li>• Data transmission                             <ul style="list-style-type: none"> <li>– Physical limitations on current trading due to Einstein’s theories and related quantum physics to finance</li> </ul> </li> </ul>  |
|             | • Laughlin et al. [18] and Wissner-Gross and Freer [22] | <ul style="list-style-type: none"> <li>• Data transmission                             <ul style="list-style-type: none"> <li>– Techniques to minimize transmission delays and execution latencies and affected price discovery when HFT firms trade securities in different locations around the world</li> </ul> </li> </ul>  |
|             | • Brogaard et al. [23] and Hasbrouck and Saar [14]      | <ul style="list-style-type: none"> <li>• Technology upgrades                             <ul style="list-style-type: none"> <li>– Exchanges upgrading for lower latencies</li> </ul> </li> </ul>  |
| • Fairness  | • SEC [1]   | <ul style="list-style-type: none"> <li>• Market structure                             <ul style="list-style-type: none"> <li>– The SEC [1] concept release directly questions the fairness of the current market structure, HFT, and the use of a variety of HFT tools and strategies</li> </ul> </li> </ul>  |

(continued)

**Table 1** (continued)

| Category                  | Authors                 | Findings by topic  |
|---------------------------|-------------------------|--|
|                           |                         | <ul style="list-style-type: none"> <li>• Unfair access concerns               <ul style="list-style-type: none"> <li>– The SEC [1] concept release directly questions if co-location provides HFTs an unfair advantage because of greater resources and sophistication to take advantage of co-location services than other market participants, including long-term investors?</li> </ul> </li> </ul> |
|                           | • Narang [24]           | <ul style="list-style-type: none"> <li>• Rebate structure               <ul style="list-style-type: none"> <li>– If the current rebate structure based on volume unfairly benefits HFT firms over non-HFT firms?</li> </ul> </li> </ul>  |
|                           | • Patterson et al. [25] | <ul style="list-style-type: none"> <li>• Insider advantages               <ul style="list-style-type: none"> <li>– HFTs are using a hidden facet of the Chicago mercantile exchange's computer system to trade on the direction of the futures market before other investors get the same information</li> </ul> </li> </ul>   |
| • Regulatory implications | • Piwowar [26]          | <ul style="list-style-type: none"> <li>• The role of speed               <ul style="list-style-type: none"> <li>– SEC Commissioner called for a comprehensive review of U.S. markets which should examine the role of speed in the markets</li> </ul> </li> </ul>  |
|                           | • SEC/CFTC (2010)       | <ul style="list-style-type: none"> <li>• Market-makers and liquidity providers               <ul style="list-style-type: none"> <li>– Whether HFT market-makers should be subject to regulations that would require them to stay active in volatile markets, rather than deserting the markets en masse and damaging liquidity</li> </ul> </li> </ul>  |
|                           | • Westbrook [27]        | <ul style="list-style-type: none"> <li>• Concerns               <ul style="list-style-type: none"> <li>– Lawmakers questioned whether the HFT practice is benefiting wall street at the expense of individual investors</li> </ul> </li> </ul>   |

[28, 29]. Since it is a new, emerging, ever changing and rapidly evolving area for the markets, regulators, and the public, this study try to provide a quantitative analysis of global empirical and theoretical HFT papers.

In this study, a traditional bibliometric method will be used to describe the latest advances in HFT. The Web of Science (WOS), which includes Science Citations Index Expanded (SCIE) and Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI) from the Institute of Scientific Information (ISI) Web of Science databases, is the most important and frequently used source for a broad review of scientific accomplishment in all fields.

Expected findings from these investigations can help researchers to realize the breadth of HFT research and to establish future research directions and to provide an entry point to any academic, regardless of their prior knowledge of the topic.

Specifically, this study will quantitatively analyze existing empirical and theoretical HFT papers to address the following objectives:

1. To reveal the developmental trends or future orientation of a new research field like HFT.
2. To get different point of view that emerge from a comprehensive review of existing HFT papers by future researchers before choosing their interested field.
3. To help to evaluate the need for regulatory intervention or regulatory purposes.

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