

High-Frequency Trading and its Impact on Retail Investors

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

High-frequency trading (HFT) has transformed the landscape of financial markets over the last few decades, becoming an essential component of modern finance. HFT refers to the use of advanced technological tools and algorithms to trade stocks and securities on the scale of nanoseconds. HFT firms invest in the latest and greatest hardware, often co-locating their servers on the same premises of the exchange to achieve ultra-low latency access (Ayres, 2021). Retail investors are common people who trade stocks and securities in their personal accounts, often saving and preparing for retirement. In this paper, I provide a comprehensive analysis of the HFT industry, with a focus on its impact on retail investors and other relevant stakeholders.

The rapid evolution of HFT can be traced back to the late 1990s and early 2000s, fueled by the development of electronic trading platforms and the increasing availability of real-time market data. Before the advent of electronic trading, financial markets were dominated by open outcry trading in the pits of major exchanges such as the Chicago Mercantile Exchange (CME) and the New York Stock Exchange (NYSE). Traders would gather in these pits, using hand signals and shouting to buy and sell securities, a process that was very chaotic and disorderly (Morrison, 2015). As technology progressed, electronic trading started to gain traction. Gradually, electronic trading platforms became more advanced and efficient, allowing market participants to execute trades with greater speed and accuracy. This shift from the trading pits to electronic markets laid the foundation for the rise of HFT, as it enabled the use of advanced algorithms and low-latency systems to exploit tiny price discrepancies in markets across the globe. Today, HFT accounts for a substantial portion of the total trading volume across major

exchanges, with proprietary trading firms, hedge funds, and investment banks as the largest players in the space.

Understanding the implications of HFT on retail investors is crucial because they represent everyone who is not a financial institution. The rise of HFT has sparked a debate over whether it enhances or harms the investing experience for most people, with arguments centered around liquidity, market efficiency, and fairness. I examine two case studies that reveal the positive and negative impacts of HFT on retail investors: the 2010 Flash Crash and the more recent GameStop Short Squeeze. These events highlight the potential consequences of HFT on market stability and investor confidence. Additionally, I will discuss the current policy and regulatory landscape, exploring potential reforms and legal efforts to address HFT-related issues.

An Overview of HFT

The key players in the HFT industry include proprietary trading firms, hedge funds, and investment banks. Proprietary trading firms are specialized trading companies that use their own capital to trade financial instruments. Their primary objective is to profit from market inefficiencies and short-term price fluctuations. Some well-known examples of proprietary trading firms include Jump Trading, Jane Street Capital, and Citadel Securities (Yang et al., 2023). Citadel Securities is the subject of the Gamestop Short Squeeze case study. Hedge funds are investment funds that utilize a wide range of investment strategies to achieve outsized returns for their investors. A key distinction between hedge funds and proprietary trading firms is that proprietary trading firms use their own capital while hedge funds accept outside investors. While not all hedge funds engage in HFT, some apply HFT strategies as a part of their larger investment approach. Some well-known hedge funds include D.E. Shaw and Bridgewater

Associates. Some investment banks also have dedicated HFT desks or smaller proprietary trading divisions within the company. These larger banks are often seeking quality execution on their trades on behalf of investors. Some examples of investment banks in the HFT space include Morgan Stanley and Citigroup.

The main strategies used across HFT firms are market-making and statistical arbitrage. Market-making is a strategy in which traders provide liquidity to the market by continuously offering to buy and sell securities at the specified bid and ask prices. The market-makers aim to profit from the difference in the bid and ask prices (known as the “spread”) while facilitating the trading process for other market participants. Market-makers maintain an inventory of the securities they trade, and part of the challenge of market-making is to hold a small position and minimize exposure. Market-makers continuously update their bid and ask prices based on the latest market information. Failure to keep up with market events can lead to holding large positions and losing money. One main criticism of market-makers is that they advertise themselves as contributors to the market via liquidity and efficiency. However, during periods of high volatility, many market-makers tend to withdraw liquidity, exacerbating price swings and undermining market stability. Critics argue that these HFT firms operate under the pretense of providing liquidity, while withdrawing during the periods where liquidity is needed most (Breckenfelder, 2020).

Statistical arbitrage is a quantitative trading strategy that seeks to exploit temporary price discrepancies between related securities. These discrepancies may arise due to temporary supply and demand imbalances or information lags. Traders use advanced algorithms to identify and capitalize on these opportunities before other market participants can react. A common form of statistical arbitrage is pairs trading. Pairs trading involves trading historically correlated

securities such as U.S. treasuries and European government bonds that have temporarily diverged in price. The trader bets that the prices will converge again, and profits from the temporary market inefficiency. Other less common examples of statistical arbitrage include index arbitrage and event-driven arbitrage. Indexes are collections of securities, and when discrepancies appear, traders are able to identify arbitrage opportunities when there are differences in price between the individual components of the index and the price offered for the index itself. Event-driven arbitrage specifically involves trading around major events such as earnings announcements or mergers and acquisitions that are expected to cause temporary price changes. Traders use historical data to predict the likely impact of the event to capture a profit.

The primary advantages of HFT include increased liquidity, reduced bid-ask spreads, and faster price discovery. Most HFT firms act as market-makers, providing liquidity by always being willing to buy and sell securities. This can help reduce price volatility and make it easier for all other market participants to trade. While critics may argue that the liquidity aspect of HFT is overstated, the reduced bid-ask spreads are undeniable. The narrowing of bid-ask spreads due to HFT competition has a positive effect on all market participants by reducing the cost of trading. In the early 1990s, most securities traded with a quarter spread. As markets became more competitive, the minimum price increment for most securities became fractional. Spreads were now 1/16th of a dollar or 6.25 cents. By the early 2000s, U.S. stock exchanges transitioned to decimal pricing, dropping the minimum price increment to one cent (Budish et al., 2015). Modern trading fees for all market participants are negligible compared to what they used to be. Price discovery is the process by which market participants determine the fair value of a security through supply and demand. With HFT firms capitalizing on every tiny inefficiency by using

algorithms to analyze real-time data and monitor news, in theory, the prices of all stocks and securities are always very accurate.

Technological Momentum

The theory of technological momentum, proposed by historian Thomas P. Hughes, provides valuable insight into the relationship between HFT and society over time. Hughes's theory synthesizes two models, technological determinism and social determinism, offering a nuanced understanding of how technology and society interact and evolve in tandem.

The social determinism phase of Hughes's theory corresponds to the early stages of HFT before the rise of electronic trading, where society exerted deliberate control over its use and scope. During this phase, HFT was a nascent technology with a limited presence in financial markets, allowing market participants, regulators, and policymakers to shape its growth and implementation.

As HFT matured and became increasingly entrenched in financial markets, it entered the second phase of technological momentum, where its deterministic force began to take hold. In this phase, HFT gained inertia as a large technological system, encompassing both technological and social components, making it difficult to influence and steer its trajectory. The widespread adoption of HFT and its integration into market infrastructure has contributed to this momentum, driving the evolution of trading practices and financial markets. The theory of technological momentum offers valuable insights for understanding the challenges and opportunities faced by regulators in addressing the risks and benefits associated with HFT. In the early phase of social determinism, regulators had greater flexibility and control over the direction and scope of HFT, allowing them to impose rules and guidelines to protect market participants. However, as HFT gained technological momentum, it became more challenging for regulators to exert influence

over its development and impact. The growing complexity of HFT strategies and the increasing speed and scale of trading has made it more difficult for regulators to fully comprehend and address the potential risks posed by HFT.

Impact of HFT on Retail Investors

The impact of HFT on retail investors is a subject of ongoing debate. Proponents of HFT point out the enhanced market efficiency, lower trading costs, and improved liquidity. Critics argue that the current landscape of HFT can lead to front-running, flash crashes, and unfair competition.

Front-running is the practice of HFT firms using their speed advantage to exploit their knowledge of pending orders and profiting from the projected price movements at the expense of other market participants. Payment-for-Order-Flow (PFOF) enables front-running and has been the subject of scrutiny by the U.S. Securities and Exchange Commission (SEC). This practice will be discussed in the Policy and Regulation section of this paper.

Flash crashes involve rapid price fluctuations during which markets experience sudden and dramatic price changes. HFT firms have been implicated as facilitators of these periods of extreme volatility, and these events can erode retail customer confidence and result in significant financial losses for those caught in the turmoil. Many critics claim that market-making firms contribute to market instability during these periods of high volatility by withdrawing their liquidity and exacerbating price swings. The 2010 Flash Crash is one of many examples of flash crashes in U.S. financial history and will be discussed in the case study.

The issues of unfair competition and market manipulation have existed since the origins of HFT. Through the years, traders have exploited loopholes and used strategies such as spoofing while the SEC struggles to keep up with their latest tricks. Spoofing is a manipulative trading

practice that negatively impacts all market participants including retail investors. Specifically, spoofing refers to the act of placing large orders with the intent to cancel them before execution, creating the illusion of substantial demand. These traders manipulate the market price in their favor to generate artificial price movements. Not only are these practices innately deceptive and harmful to the marketplace, but they also counteract some of the pros of HFT. While proponents of HFT argue that efficient price discovery is important, spoofers and manipulators can prove the opposite in many cases. This paper will examine specific cases of proven spoofing, stock manipulation, and the consequences in the policy and regulation section.

Case Study 1: The 2010 Flash Crash

On May 6, 2010, U.S. financial markets experienced a sudden and dramatic event known as a “flash crash.” Flash crashes are typically characterized by extreme volatility and often occur within a short time frame, typically minutes or even seconds. On this particular Thursday afternoon at approximately 2:32 PM the Dow Jones Industrial Average (DJIA) plunged by approximately 9% within a couple of minutes, only to recover most of its losses shortly thereafter (Hulbert, 2019). The DJIA is a stock market index of 30 of the most prominent companies listed on U.S. stock exchanges. Critics of HFT rushed to cite liquidity withdrawal and positive feedback loops as causes for the massive flash crash.

The SEC teamed up with the Commodity Futures Trading Commission (CFTC) to investigate the incident and determine who was responsible. The investigation was led by Gregg E. Berman, a senior advisor in the Division of Risk, Strategy, and Financial Innovation at the SEC (SEC, 2010). After almost five months of investigation, on September 30, 2010, the SEC and CFTC released a joint report titled “Findings Regarding the Market Events of May 6, 2010.” In regard to the role of HFT in the flash crash, the investigators reported that “HFTs began to

quickly buy and then resell contracts to each other—generating a “hot-potato” volume effect as the same positions were rapidly passed back and forth. Between 2:45:13 and 2:45:27, HFTs traded over 27,000 contracts, which accounted for about 49 percent of the total trading volume, while buying only about 200 additional contracts net” (CFTC and SEC, 2010). In other words, the HFT firms were buying and selling these contracts to and from each other and drastically impacting the price without any actual intent to hold the contracts. The report also confirmed suspicions that many HFT firms and other market-makers reduced their trading activity or withdrew from the market altogether, exacerbating the liquidity issue and contributing to the rapid price decline. It was also determined that HFT firms deployed algorithms programmed to react to market conditions and these algorithms began to sell aggressively in response to the falling prices with no human involvement. This selling pressure further contributed to the downward price spiral, creating a vigorous positive feedback loop.

The 2010 Flash Crash had substantial implications for retail investors. Many investors experienced significant financial losses due to the extreme price volatility. Some were forced to sell their positions at a hefty loss due to stop-loss orders triggered at unfavorable prices. Stop-loss orders are a risk management tool used by investors to limit potential losses on a security. An investor specifies a price at which their security should be sold automatically if its market price falls to that level, helping to prevent further losses in case of a sudden market downturn. Many retail investors had stop-loss orders which were executed during the flash crash. HFT firms bought their indexes relatively cheaply while the price was plummeting, and 30 minutes later when the price re-stabilized, the retail investors ended up with significant losses while the HFT firms ended up with the profits.

The flash crash eroded retail investors' confidence in the integrity and stability of financial markets. Many investors questioned the fairness of a market where sophisticated HFT firms could have such a significant impact on the price movements of one of the world's largest, most liquid indexes. The increased regulatory scrutiny in response to this crash also led to the implementation of new regulations and safeguards such as circuit breakers, specifically designed to prevent similar events from occurring in the future. The circuit breakers implemented automatic trading halts designed to prevent extreme market volatility. These mechanisms temporarily pause trading in individual securities or entire markets when predefined price thresholds are breached, allowing regulators and market participants to assess the situation and restore order (Clark, 2010).

Case Study 2: HFT and the GameStop Short Squeeze

The GameStop short squeeze in January 2021 emerged as a notable event in financial market history. Retail investors banded together to drive up the share price of the struggling video game retailer. In media, the primary focus was on the role of social media platforms like Reddit and the surge of retail investors using Robinhood to place risky options bets. HFT firms also played an important role in the event, and I will investigate the relationship between retail investors and HFT firms during this period of extreme volatility.

HFT firms, acting as market-makers, played a key role in providing liquidity during the GameStop short squeeze. As the trading volume of GME (the ticker for GameStop Corp.) shares surged, HFT firms helped facilitate the execution of buy and sell orders, enabling retail investors to participate in the rally. The increased trading activity and volume also contributed to wider bid-ask spreads, which HFT firms capitalized on.

During the short squeeze, two prominent firms: Citadel Securities and Melvin Capital, played significant roles in the unfolding of the event. Their involvement showcases the complex dynamics between market-makers, hedge funds, retail investors, and regulators in today's financial markets. Citadel Securities is a leading market-maker and a subsidiary of Citadel LLC, a global hedge fund. Citadel Securities specializes in HFT and provides liquidity across various asset classes including equities, futures, and options. Citadel Securities handled a substantial portion of the trading volume in GameStop shares and options during the short squeeze.

As retail investors flocked to buy GameStop shares and options, concerns were raised about a potential conflict of interest, given that Citadel Securities' parent company had a sizable investment in Melvin Capital. Melvin Capital was a hedge fund specialized in short-selling. The fund had a significant short position on GameStop, betting on a decline in the company's share price. As the share price soared due to the coordinated buying efforts of retail investors, Melvin Capital faced mounting losses. To stem its losses and meet margin requirements, Melvin Capital was forced to close out its short position in GameStop at a crushing loss. To assist with this, Melvin Capital received a \$2.75 billion capital infusion from Citadel and Point72 Asset Management to help stabilize its financial position (Chung, 2021). This connection between Citadel Securities, Citadel LLC, and Melvin Capital raised concerns as Citadel Securities profited from the increased trading volume while its parent company provided financial support to Melvin Capital. It seemed like Citadel couldn't lose, and this angered both retail investors and regulators.

Policy and Regulation

The rise of HFT and its impact on retail investors have prompted regulators and policymakers to examine the potential risks and benefits associated with the financial landscape.

This section will discuss existing and proposed policy measures aimed at addressing concerns related to HFT and ensuring a fair and stable financial market.

Existing regulations include the Regulation National Market System (Reg NMS) established in 2005 by the SEC, the Dodd-Frank Wall Street Reform and Consumer Protection Act enacted in 2010, and the Market Access Rule implemented by the SEC in 2010. Reg NMS is a set of rules designed to modernize and strengthen the national market system for equities trading. Among its provisions, Reg NMS introduced the Order Protection Rule, which requires trading centers to prevent “trade-throughs” by ensuring that orders are executed at the best available price (Chung and Chuwonganant, 2012). This meant that no matter which exchange any given trade was routed to, if there was a better available price on a different exchange then the investor would receive the best execution. This rule benefited retail investors by protecting their right to quality execution on their orders. It also inadvertently facilitated the growth of HFT by encouraging trading competition among trading venues and fostering a race for speed.

The Dodd-Frank Wall Street Reform and Consumer Protection Act introduced various financial market reforms aimed at increasing transparency and reducing systemic risks. The legislation granted the SEC and the CFTC the authority to regulate many HFT practices, such as spoofing and other manipulative trading strategies. Section 619 of the Dodd-Frank Act also enacted the Volcker Rule which prohibits banks from engaging in proprietary trading for their own profit rather than on behalf of their clients. This limited their investments in hedge funds and private equity funds to reduce the risk-taking activities of banks and prevented potential losses that could threaten their customers’ funds. This reform also resulted in the establishment of the Consumer Financial Protection Bureau (CFPB) which was created to protect consumers from unfair, deceptive, or abusive practices in financial services. The CFPB has the authority to

enforce consumer protection laws, supervise financial institutions, and issue future regulations to ensure transparency and fairness in the market (Bush, 2017). Finally, the legislation introduced provisions to enhance corporate governance and hold executives accountable. These provisions include requirements for “say-on-pay” votes, where shareholders can vote on executive compensation packages, and the “clawback” rule, which allows companies to recover incentive-based compensation from executives in case of financial restatements due to misconduct.

The Market Access Rule, also known as SEC Rule 15c3-5, was adopted by the SEC as a response to the rapidly evolving electronic trading landscape, including the growth of HFT. The rule aims to reduce the risk of market disruptions and manipulative trading practices by requiring broker-dealers to implement risk management controls and supervisory procedures. The rule required broker-dealers to establish procedures to prevent the entry of orders exceeding pre-set credit or capital thresholds, thus reducing the likelihood of potentially destabilizing trading activity such as submitting large volumes of orders that could disrupt market functioning (Architzel, 2013). Additionally, the rule’s supervisory procedures help mandate that broker-dealers are not influenced by third parties or clients who might have an interest in circumventing these controls. This resulted in enhanced market stability, greater accountability, and increased compliance costs.

Critics of HFT point to the heavily regulated European markets of Italy, Spain, and France. Regulations on HFT are much stricter in these countries, and as a result, these markets have a much smaller HFT presence. Italy introduced a Financial Transaction Tax (FTT) in 2013, which imposes a levy on the purchase of shares and equity options (Miller and Tyger, 2020). The FTT is designed to discourage short-term, speculative trading, including HFT strategies. The tax contributed to a reduction in HFT activity in Italy, as the increased transaction costs make high-

frequency, low-margin strategies substantially less profitable. Firms in Italy are also subject to more rigorous market-making obligations, requiring them to provide continuous bids and asks for a minimum percentage of the trading day (Committee on the Global Financial System, 2014). These obligations ensured that HFT firms actually contribute to market liquidity and do not withdraw during periods of high volatility. Spain and France share similar market-making obligations. France has also implemented rules that limit the order-to-trade ratio for HFT firms, which restricts the number of orders that can be placed without resulting in a trade (Jeffs and Miedema, 2012). This measure reduces manipulative practices by HFT firms and makes it more costly for firms to place and cancel orders without executing trades. The European Parliament also tried to introduce a minimum holding period for securities of 500 milliseconds, and although this was never passed it would have effectively removed any HFT presence in their markets (Sobolewski, 2013).

Finally, the more recent controversy over PFOF and the SEC's attempt to ban it in 2022 will be investigated. PFOF is a practice where retail brokerage firms such as Vanguard and Charles Schwab receive compensation from market-makers for directing their clients' orders to them for execution. This compensation can take the form of cash payments, rebates, or discounts on trading fees. One of the concerns associated with PFOF is the potential for front running, where HFT firms are able to trade ahead of a client's order and profit from the anticipated price impact of that order. HFT firms and market-makers gain access to valuable information about the trading intentions of retail investors. Outside of front running, PFOF creates another conflict of interest where retail brokers may be incentivized to route orders to market-makers offering the highest PFOF, potentially compromising the execution quality of their investors' orders. While the SEC decided not to ban PFOF due to liquidity concerns, they took several measures to

address the issue. They established best execution obligations, requiring retail brokers to seek the most favorable terms reasonably available for their clients' orders (Losurdo, 2023). This requirement is intended to ensure that retail brokers prioritize their clients' interests over their own when routing orders, regardless of PFOF. Furthermore, the SEC implemented rules that require retail brokers to disclose information about their order routing practices, including the amount of compensation received through PFOF on a quarterly basis (Chretien 2021). These disclosures aim to increase transparency and enable retail investors to make informed decisions about their choice of brokerage.

Conclusion

HFT presents a complex and paradoxical issue for financial markets. On the one hand, HFT has brought about numerous benefits such as enhanced market efficiency, lower trading costs, and improved liquidity. On the other hand, it has introduced new challenges, including front-running, flash crashes, and unfair competition, which can negatively impact retail investors and the overall stability of financial markets.

To strike the right balance between harnessing the benefits of HFT and mitigating its potential risks, policymakers and regulators must carefully consider the available regulatory options and learn from the experiences of other jurisdictions. For instance, European countries like Italy, Spain, and France had implemented stricter regulations on HFT, such as financial transaction taxes and market-making requirements. However, these regulations may also have unintended consequences, such as reduced liquidity and higher average trading costs. In light of these considerations, U.S. regulators may benefit from exploring the adoption of certain regulatory measures from European regulators while carefully tailoring them to the unique characteristics of the U.S. financial markets. This could involve implementing targeted rules that

address specific risks associated with HFT, such as enhancing disclosure requirements for PFOF, imposing stricter market-making obligations on HFT firms, and introducing further mechanisms to prevent market manipulation and abuse.

Ultimately, the challenge for regulators is to create a regulatory environment that encourages innovation and efficiency in financial markets while ensuring the protection of retail investors and the overall stability of the financial system. By adopting a balanced and evidence-based approach to HFT regulation, policymakers can navigate the world of HFT and promote a fair and resilient financial market for all participants.

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