

Towards Bipartisan Regulation of High Frequency Trading

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CS 181W: Computers, Ethics, and Public Policy

Final Paper

June 7, 2017

Executive Summary

High frequency trading (HFT), which has existed in the United States for several decades, expanded rapidly and in relative secrecy in the early 2000's, with total industry revenue exceeding \$7 billion in 2009 [8]. Firms that engage in HFT rely on incredibly fast software and network connections to exchanges, and use these capabilities to trade stocks rapidly and often aggressively. Considerable debate exists over the role of HFT firms – some allege that their practices are anticompetitive and exploitative, while others cite their ability to bolster liquidity, with both government regulators and private companies on both sides of this debate. Though several reforms have been enacted by organizations such as the SEC, many have failed to curb abusive trading tactics and have harmed liquidity in the process.

This report analyzes both the role of HFT firms as well as previous attempts to regulate them, and develops a fiscally bipartisan solution: tax subsidies for “fair” exchanges together with an experimental securities transaction tax, designed to limit exploitative trading without placing undue burden on financial markets.

Introduction

In the introduction to his book *Flash Boys*, author Michael Lewis describes a \$300 million project by Spread Networks to lay a perfectly straight cable connecting datacenters outside New York and Chicago, designed to reduce transmission time from 17 milliseconds to 13 milliseconds [11]. While such an improvement may seem unimportant at first glance, the first 200 users to sign up for access to the Spread Networks cable paid a collective \$2.8 billion [20]. These users were primarily companies that engaged in high-frequency trading (HFT), for whom 4 milliseconds was the difference between dominance and irrelevance. To an outsider, this furious competition for milliseconds and even microseconds appears to be a waste of resources, but it is in reality a race for very real money: high frequency trading generated \$7 billion in revenue in the US alone in 2009 [8].

Technical Background

Definition

High frequency trading is a subset of automated trading, in which financial transactions are issued by computers without direct human input. HFT specifically is characterized by large numbers of orders and cancellations, short holding periods, low latency times (often on the scale of milliseconds or microseconds), and a focus on highly liquid instruments (that is, instruments that are easily bought and sold) [8].

History

1930-2009: Emergence

HFT in its current form was born with NASDAQ's introduction of purely electronic trading in 1983 [6], which allowed for communication orders of magnitude faster than was previously possible. The industry grew rapidly, reaching its peak in 2009, when trades made using HFT software comprised 60% of all equity trading in the United States [8].

2009-Present: Decline and Maturity

HFT has declined slightly since 2009 (today comprising only 50% of all equity trading), though by no means disappeared, for several reasons:

1. HFT is inherently predisposed to profit from high market volatility - a condition that characterized the financial crisis of 2009 but has since diminished. [16]
2. HFT also relies on high market volume, which has diminished along with investor confidence in the wake of two shocks to the market since 2009: the Flash Crash of May 6, 2010 (in which the Dow Jones Industrial Average dropped 600 points in the span of 5 minutes) [9] and the Knight Capital meltdown in August 2012 (in which Knight Capital lost \$440 million dollars in a single day due to faulty automated trading code) [15].
3. HFT was considerably more lucrative when practiced in relative secrecy by a select few. Once knowledge of these practices became public knowledge (starting with a *New York Times* article in 2009 [7]), increased competition in the sector normalized once-tremendous profits.

Though HFT has seen a decline both in share of market volume and total revenue since 2009, it still remains a billion-dollar sector, and one that could reemerge in an inevitable period of greater volatility.

High Frequency Trading Strategies

The potential reemergence of HFT necessitates an understanding of the practices employed in the sector, both during its 2009 heyday and today.

Co-location

Co-location is the practice of “locating computers owned by HFT firms ... in the same premises where an exchanges computer servers are housed,” with the goal of enabling faster access to exchange data. Co-location “has become a lucrative business for exchanges, which charge HFT firms millions of dollars for the privilege of ‘low-latency access’”. Co-location and privileged

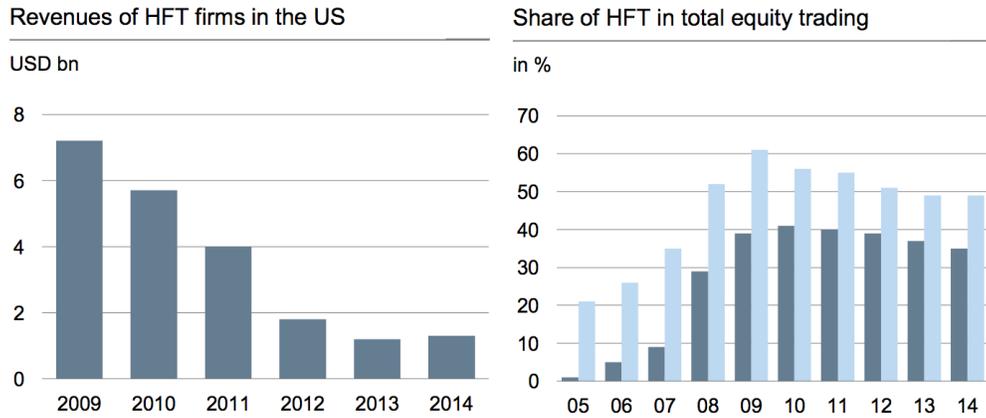


Figure 1: Graphs showing the relative decline of high-frequency trading since the financial crisis of 2009. In the graph on the right, dark blue bars indicate European markets, while light blue bars represent American markets. Source: Deutsche Bank Research [8]

low-latency can create a market of haves and have-nots, where the resource in question is not money directly, but rather speed, which begets money [17].

Front-Running

The term “front-running” has several different uses. Here, we use it to refer to a practice by which an HFT organization recognizes a trade occurring on one exchange and quickly acts to take advantage of that trade before it can occur on another exchange. An example timeline is:

1. Investor *I* places an order for 100 shares of stock *S*, which is currently valued at \$20.00. This order is divided into 4 orders for 25 shares of stock *S*, each of which is sent to a different exchange, *W*, *X*, *Y*, *Z*. Until one of these trades reaches its exchange, knowledge of this movement is unknown to the public.
2. Investor *I*'s order on exchange *W* is executed, and is broadcast to the public. Investor *I* has longer latency to exchanges *X*, *Y*, *Z*: these orders have not yet executed.

3. HFT organization H notices investor I 's order on exchange W and suspects that they might make similar trades on other exchanges. Using their faster connection and lower latency, they quickly place orders on exchanges X, Y, Z . They purchase the stock for \$20.00 per share.
4. Investor I 's orders arrive at exchanges X, Y, Z . Investor I 's demand on these exchanges raises the price to \$20.01 per share.
5. HFT organization H quickly sells these shares, making a profit of \$0.01 per share. With sufficient volume, H can make a considerable profit.

Under current law, this practice is legal, though questionably ethical. "Front-running" in most cases refers to the practice of using "material, nonpublic information" to predict and exploit market movement (e.g. a CEO who knows that his company's earnings report will be low, and sells shares ahead of a probable drop in share value). However, because the variety of front-running described in the example relies only on *public* information, it cannot be prosecuted under this framework [17].

Front-running is similar to "slow market arbitrage," in which rather than targeting a particular transaction on a particular exchange, an HFT organization will simply monitor the value of instruments on different exchanges for a price difference. When a price difference is present, the firm can exploit the arbitrage opportunity, buying at the lower price and selling at the higher price.

Spoofing

The Dodd-Frank Wall Street Reform and Consumer Protection Act ("Dodd-Frank") defines spoofing as "the illegal practice of bidding or offering with intent to cancel before execution." Spoofing was a technique employed by HFT organizations to create the illusion of supply or demand for a particular financial instrument, in an attempt to manipulate prices to their advantage. Spoofing occurred regularly until it was banned under Dodd-Frank in 2010, and still occurs in limited amounts today [13].

Technical Conclusions

High frequency traders employ a variety of techniques to manipulate financial markets to their advantage, generating on the order of \$1 billion of revenue annually. Though the sector has declined with growing economic stability, its still-considerable magnitude demands understanding and regulation.

Public Policy Background

Arguments Supporting HFT

Market Quality

A report from the Congressional Research Service (CRS) recounts how surveys suggest that “HFT appears to have narrowed bid ask spreads, bolstered market liquidity, reduced some measures of price volatility, and improved the price discovery process.” [18]

The process by which HFT bolsters market liquidity is apparent: HFT firms make money by interacting with financial markets, and thus are constantly trading, ensuring that other market participants will have a partner with whom they can trade.

HFT firms can reduce market volatility through tactics which attempt to rapidly buy and sell a particular financial instrument: because HFT firms buy low and sell high on a very short time span, they exert downward pressure on too-high prices and upward pressure on too-low prices, acting as a stabilizing influence. Here, the CRS is careful to differentiate between “aggressive” and “passive” HFT, noting that “passive as opposed to aggressive HFT strategies [tend] to reduce intraday volatility.” [18]

The CRS is also careful to note that “correlation is not necessarily causation: various changes in equity market structure from developments such as decimalization ... [and others] ... likely also played roles and it is hard to disentangle their individual roles.” [18]

Arguments Against HFT

Lack of Dependable Liquidity

While HFT firms do create liquidity, some question their dependability, noting that “high-frequency trades... generally lack depth because of the relatively small size of HFT quotes [trade quantities].” [18] Additionally, many HFT firms are not designated market makers (DMMs). DMMs have an obligation to make a market (that is, buy and sell at market price) in some security, even if this might mean operating at a loss. Because HFT firms have no such obligation, the liquidity they provide can vanish under certain conditions.

Unfair Markets

Practices such as front-running do not constitute insider trading, because they do technically rely on *public* information. However, the ability to use this public information relies on millions of dollars of technology and privileged access via co-location. While it is true that these opportunities for the fastest possible access to financial information are available to any organization willing to pay for them, the barrier to entry is sufficiently high so as to create a two-tiered market, in which some organizations have access to information before others do, giving them an advantage.

Defenders of this system note that “securities markets have always been characterized by differential or tiered access to securities trades, going back to a time when floor traders had favored access to stock orders.” [18] Even today, these defenders assert, the public doesn’t view people who use free stock quotes via Google Finance (normally up to 20 minutes behind markets) as being “disadvantaged” with respect to people who use stock quotes via paid services such as Bloomberg (normally within seconds of live market movement). Rather, the public acknowledges that the Bloomberg user’s advantage is the result of their decision to purchase access to Bloomberg’s services [14]. However, critics assert that this argument is simplistic, and that because investment in millisecond-level improvement is generally only profitable for HFT firms, paid access for extremely low latency can and does create tiered access to information.

Investor Confidence

HFT may also be detrimental to investor confidence. To those in the financial industry not directly involved in the development of HFT technology, the sector is a black box, with algorithms producing trading activity that may be difficult for humans to analyze or explain. However, these financial analysts may recognize that they cannot understand and master every concept within the industry, and decide to “leave HFT to the HFT people.”

However, even if financial analysts place their trust in HFT professionals, the general public is far less likely to do so, especially in light of a string of highly public market disruptions that were (correctly or incorrectly) attributed to reckless practices by HFT firms, the most notable among these being the Flash Crash of May 6, 2010 and the Knight Capital Group meltdown [9] [15]. Investor confidence is vital to any economy, as high investor confidence means that the general public is willing to place their financial resources in the hands of capital markets. If HFT “black boxes” play a role in reducing investor confidence, they impede capital markets, making it more difficult for people and businesses in need of loans to acquire them and thus slowing economic growth.

Government Regulation Surrounding HFT

Much of the current regulation surrounding HFT in the United States has been put forth by the United States Securities and Exchange Commission (SEC), whose mission is “to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation.” [5] SEC initiatives to date have been directed primarily towards increasing the accountability of HFT firms.

Market Information Data Analytics System (MIDAS)

To improve its ability to monitor HFT firms for abusive and illegal trading practices, the SEC has implemented programs including MIDAS (Market Information Data Analytics System). MIDAS was adopted in 2013 to capture all orders, modifications, cancellations, and trades conducted on national exchanges, as well as off-exchange executions, providing the organization

with an unprecedented ability to aggregate trade data and monitor HFT firms (and other market participants) for abusive behavior [2].

Large Trader Reporting Rule (LTRR)

In 2011 the SEC adopted the Large Trader Reporting Rule (LTRR), which “requires large¹ traders to identify themselves to the SEC, which ... [assigns] each trader a unique identification number.” This number is used by broker-dealers to maintain transaction records for each large trader, which can be accessed by the SEC upon request. The LTRR provides another method by which the SEC can monitor the practices of HFT firms to ensure accountability [3].

Private-Sector Opposition to HFT

In addition to expected government regulation from the SEC and others, opposition to HFT has come from another, more unexpected source: the private sector. For strategic or ethical reasons, multiple financial companies have taken stances against HFT, most notably IEX - the Investors Exchange.

IEX is a stock exchange created by former Royal Bank of Canada (RBC) analyst Brad Katsuyama. After determining that he had been the unknowing target of HFT front-running (during an era in which few people outside of HFT firms knew these tactics existed) during his tenure at RBC, Katsuyama and his team searched for countermeasures. Initial attempts (such as software that would ensure that all issued trades arrived at different exchanges at the time same, preventing front-running) met limited success. Searching for new solutions, Katsuyama and his team began to conceive of a design for a new stock exchange - one that would prevent predatory tactics by HFT firms. IEX’s solution to a market dominated by speed was to introduce a speed bump in the form of a 38-mile fiberoptic cabled coiled in the server room of their stock exchange, meaning that any traffic interacting with the exchange would have to pass through this cable and incur a

¹Large traders here are defined by the SEC as “entities who trade either 2 million shares or \$20 million during any calendar day; or 20 million shares or \$200 million during any calendar month” [3]

350-microsecond delay - too short to affect normal trading, but long enough to prevent front-running [10].

Surprisingly, IEX, an exchange dedicated to the idea of prudence and fairness in financial markets (perhaps at the cost of efficiency) received the support it needed from Goldman Sachs - a bank frequently associated with “moral bankruptcy” (see “Why I Am Leaving Goldman Sachs”, by Greg Smith [19]) and the imprudent lending practices that led to the 2009 financial crisis.² With the backing of a large investment bank, IEX was able to meet operating costs and thrive, and today facilitates the exchange of over 100 million shares per day [1].

Conclusions on Policy

The significant scope of the positive and negative effects of HFT on financial markets necessitates an understanding of a financial sector that for many years profited from operation in relative secrecy. The industry’s potential to increase market efficiency by raising liquidity and stabilizing prices cannot be overlooked. However, the tendencies of HFT to create unreliable liquidity, foster tiered information access, and reduce investor confidence must also be considered. Finally, the factions in the debate surrounding HFT must be taken into account: the existence of public and private sector opponents and proponents means that policy could take multiple forms. Responses could consist of direct regulation (e.g. via the SEC), or could instead be intended to influence the industry using the private sector as a proxy (e.g. via tax incentives).

Public Policy Recommendations

Thus far, this report has provided unbiased background information on the technology and public policy surrounding high frequency trading.

²Goldman’s decision should be interpreted as strategic rather than magnanimous - the firm engages in a variety of financial services, most notably investment banking and investment management, and did not have a strong footing in HFT when IEX opened in 2013. The fact that Goldman began recruiting heavily for its own HFT division “Sigma X” seems to reinforce this hypothesis. [12]

Having established this factual basis, this report will discuss and develop recommendations for further public policy surrounding HFT.

An Apolitical Argument Against HFT

Debate surrounding public policy and HFT is inextricably tied to the considerably more complicated debate surrounding the relative merits and detriments of different economic systems, and which of these systems is best for a country such as the United States. Too often, discussions surrounding financial legislation can be reduced to differing underlying economic philosophies, issues on which few legislators and pundits are willing to compromise their beliefs. This report will avoid such unproductive discourse by considering debate around HFT from both fiscally liberal and fiscally conservative perspectives, representative of most of the spectrum of economic philosophy in the United States.

The Fiscally Conservative Perspective

Moderate fiscal conservatism in the United States generally holds that little government intervention in the market is preferable, and that a lack of regulation results in higher profits, which incentivizes businesses to enter the market, innovate, and create value. While under this system of thought little regulation is preferable, some is necessary: fiscal conservatism acknowledges the existence of negative externalities (e.g. a factory polluting a nearby river) that will not be regulated by the free market, and thus must be regulated by government.

One central component of fiscal conservatism is that companies unfettered by regulation and taxation are better able to create value and create a more prosperous country for citizens, reducing the need for social programs. Examining HFT under this lens begs the question: do firms that engage in high frequency trading create value?

Is there value in “spoofing” – creating large-volume trades to manipulate market prices, profiting off of that shift, and canceling the original trades before they can be executed?

Is there value in “front-running” the trades of market competitors – seeing their trades on one market, and exploiting that knowledge before

those trades arrive milliseconds later at another market?

These techniques are designed to exploit an advantage held by HFT firms over other market participants, and are intended to extract profit without creating value. Thus, under fiscally conservative philosophy, these practices are unproductive and even actively harmful to an economy, and should be restricted.

It is important to qualify this claim: under a fiscally conservative perspective, not all tactics practiced by HFT firms should be restricted. This argument has taken a stand against aggressive, exploitative techniques by HFT firms, but takes no such stand against passive techniques, such as simple market-making. Creation of liquidity by market-making HFT firms promotes efficient exchange and fosters access to capital markets, both of which are core goals within a fiscally conservative framework.

The Fiscally Liberal Perspective

Fiscal liberalism begins with a philosophical basis somewhat orthogonal to that of fiscal conservatism, but, counterintuitively, arrives at the same conclusion.

Moderate fiscal conservatism in the United States generally holds that the ability of the free market to regulate itself is limited, and that some substantial level of government intervention is necessary for a healthy economy. Fiscal liberalism asserts that a lack of regulation allows and encourages companies to engage in practices that treat consumers and other market participants unfairly. Under this system of thought regulation and relatively high taxation to fund social programs are necessary and helpful, but the free market still has the potential to create value and should be allowed to operate with some degree of autonomy.

Abusive practices such as spoofing and front-running by HFT firms are exactly the kind of harmful practices that fiscal liberalism asserts that businesses will pursue in the absence of sufficient regulation - these practices are tantamount to millions of daily instances of legalized microtheft. Under fiscal liberalism, government regulation of this sector is necessary to prevent HFT firms from gaining a permanent and cyclically reinforced advantage in financial markets, one which will lead to monopolistic structures and hinder competition and growth.

Partisan Cohesion and Dissonance

Surprisingly, fiscal conservatism and fiscal liberalism can be applied to derive the same conclusion condemning more aggressive measures by HFT firms such as spoofing and front-running. However, one area where the two philosophies exhibit dissonance is in their treatment of more passive measures, such as market-making. Fiscal conservatism would support low taxes for market makers, to encourage unfettered exchange, while fiscal liberalism would levy higher taxes on market makers, under the assertion that the corresponding increase in government revenue would more than offset the small inefficiency introduced by a tax.

Thus, the most pertinent questions in crafting a bipartisan solution become how best to discourage more abusive, aggressive practices by HFT firms outright, and how to reconcile conflicting perspectives on the necessity of regulation and taxation on passive HFT tactics.

Potential Measures

In its report on the subject, the Congressional Research Service considers several potential legislative responses to the proliferation of HFT. This essay considers them in turn, along with its own proposals [18].

Congressional Research Service Proposals

Order Cancellation Fees The CRS considers “imposing penalty charges for excessive order cancellations,” a practice which would discourage HFT traders from “posting orders they do not intend to execute or using cancellations as part of manipulative strategies like spoofing.” This proposal is countered by the argument that HFT firms must rapidly adapt to market conditions in order to provide liquidity, and that this adaptation often involves the rapid cancellation of orders that were genuine (that is, intended to be executed, and not an instance of spoofing) when they were placed. Under this proposal, it is possible that HFT firms would be more hesitant to place trade orders, reducing liquidity.

Minimum Order Exposure Times The CRS also considers a scheme under which “submitted securities orders could not be canceled for some minimum duration, for example 50 milliseconds”. This proposal meets discourse similar to that surrounding order cancellation fees: proponents cite its potential to eliminate abusive practices, while critics cite its potential to reduce the ability of market makers to provide liquidity.

Securities Transaction Tax Finally, the CRS considers placing a tax on HFT trades specifically, similar to one implemented by Italy in December 2013 [4]. The Italian legislation created a tax of 0.02%, which “applies to any portion of changed or canceled daily orders where the ratio of the changed or canceled orders less than half a second in duration exceed 60% of the total number of submitted orders.” Importantly, the tax “does not apply to market makers.” As the tax was recently implemented, its merits are still being evaluated. However, as with the previous two proposals, debate centers on whether such a proposal excessively limits liquidity.

Novel Proposals

Tax Incentives for Fair Exchanges Observing that all measures issued by the CRS become bogged down in debates regarding the potential impact of such legislation on market liquidity, this report explores policy which would have insubstantial impact in this respect: tax incentives for “fair” exchanges, such as IEX. Fair exchanges eliminate many of the problems associated with aggressive HFT practices, such as front-running, without the need for hard-to-enforce legislation. Tax incentives for exchanges that promote fair trading (or, conversely, tax penalties against firms that refuse to implement such policy) promote fair markets without limiting the ability of HFT firms to offer liquidity.

Limited Action Finally, one “non-proposal” is to consider taking very limited or no action in response to HFT. This proposal points to the fact that HFT has been in relative decline since 2009 (see “2009-Present: Decline and Maturity” and figure 1). This is a valid possible response, but it ignores the fact that HFT has declined primarily as a result of increasing market stability since the 2009 financial crisis, and additionally ignores the possibility of

a resurgence in a future period of financial instability. Nonetheless, this proposal contributes the valuable insight that HFT is not as powerful a sector as it once was, and that regulation should adjust accordingly.

Recommendation

Having examined proposed public policy in response to HFT, and constructed public policy of our own to remedy potential pitfalls in pre-existing proposals, we make the following recommendations.

First, as noted in “Tax Incentives for Fair Exchanges”, we recommend the implementation of tax benefits for exchanges such as IEX which implement policies that promote fair market exchange. These policies do not pose a financial burden on HFT firms, allowing them to provide liquidity; simultaneously, these policies will help curb aggressive and harmful trading practices such as front-running.

Additionally, we recommend the experimental, gradual, and mild introduction of a securities transaction tax, with the understanding that this introduction must be conducted carefully because it will reduce market liquidity to some extent. This legislation recognizes a tradeoff between promoting liquidity and limiting unproductive HFT tactics and proposes experimentation with acceptable points on that tradeoff by varying the securities transaction tax as appropriate, to find an acceptable balance between the two objectives.

Conclusion

As the technological, political, and financial landscape around high frequency trading grows ever more complex, it is important to develop and test policy that appropriately responds to this growing complexity. With prudent regulation, the government should strive to strike a bipartisan balance between creating healthy free markets and restricting unhealthy trading tactics, to promote long-term economic stability in this sector and throughout the American economy.

Word Count

The body text of this essay (not including headings, footnotes, captions, references, or the glossary) is 4000 words.

Significant Revisions

As this is the final submission of this essay, the course staff have requested a summary of significant revisions from the first draft. My significant revisions were as follows:

1. Removal of redundant paragraph in the introduction, which simply repeated information from the executive summary.
2. Numerous small edits to clarify potentially confusing financial jargon, or provide context around financial discussion where needed.
3. Numerous edits to reduce verbosity throughout.

Author's Note

This essay attempts to the maximum possible extent to avoid overcomplicated financial jargon. Nonetheless, some discussion of concepts that may not be accessible to readers from other fields is necessary. As such, we provide this glossary for terms that may be unfamiliar to all readers.

Glossary

Ask Price	The price at which a financial instrument can be bought.
Bid Price	The price at which a financial instrument can be sold.

Bid-Ask Spread	The difference between the bid price and the ask price. That is, the difference between the price that investors are willing to pay for an instrument and the price that other investors are willing to sell it for.
Colocation	The practice of location computers owned by trading firms in the same premises where an exchange's computer servers are housed. Colocation allows for the fastest possible communication with an exchange.
Exchange	A private company that hosts financial transactions as a service. Traders submit orders to an exchange, and the exchange pairs buyers with sellers to facilitate transactions. Examples of exchanges include the New York Stock Exchange (NYSE), NASDAQ, and IEX.
Front-Running	The practice of recognizing trades from a high-latency trader on one exchange, and using low latency to anticipate those trades on other exchanges. Front running is legal in the United States, as legislation around it is difficult to define precisely.
HFT Firm	High Frequency Trading Firm. A firm that engages in high-frequency trading.
Insider Trading	Insider trading is buying and selling of a security by someone who has access to <i>material, nonpublic information</i> about the security. Here, material means "of meaningful value."

Latency	The time that it takes a market participant to communicate with an exchange. For firms that engage in high-frequency trading, low latency is extremely important.
Liquidity	A term used to describe how easily an asset can be converted to cash. A highly liquid instrument is easily bought and sold.
Price Discovery	The process by which the value of a security is established through market supply and demand dynamics.
Security	A fungible, negotiable, financial instrument that holds some type of monetary value. Examples of securities include stocks, bonds, and options.
Slow-Market Arbitrage	A practice in which trading firms with low-latency access to multiple exchanges monitor identical or correlated assets for price differences on the different exchanges, and conduct arbitrage for risk-free profit when the opportunities arises.
Spoofing	The practice of submitting a large number of buy or sell orders with the intent to cancel them before they are executed, normally to create the illusion of supply or demand in order to manipulate financial markets to one's advantage. Spoofing is illegal in the United States under Dodd-Frank.

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