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High Frequency Trading Do Regulators Need to Control this Tool of Informationally Efficient Markets?

by Holly A. Bell

Executive Summary

High Frequency Trading (HFT) is a form of algorithmic trading where firms use high-speed market data and analytics to look for short-term supply and demand trading opportunities that often are the product of predictable behavioral or mechanical characteristics of financial markets. Often called “equity market making,” HFT firms usually hold their positions for less than a minute while perpetually looking for opportunities to buy and sell. These transactions happen thousands of times a day, take microseconds, and often net less than a penny in profit per share traded.

Concerns have been raised in recent years about the potential market risks associated with HFT and algorithmic trading in general. Some opponents have argued that these practices create risk and require aggressive regulation. Purported risks to the stability and integrity of financial markets created by HFT include the creation of a two-tiered market system as a result of asymmetric information, potential vola-

tility, “noise” and informational distortions, out-of-control algorithms, and “flash crashes.” However, many of these concerns are neither new nor exclusively related to HFT.

HFT is, quite simply, a contemporary tool that facilitates informational market efficiency and, as such, is capable of being regulated by the market and market participants—indeed, there is significant evidence to indicate HFT activity is already being regulated by the market. At the same time, HFT improves market efficiency by lowering the costs to investors, controlling volatility, and improving liquidity. Many of the concerns raised by those calling for increased regulation predate the emergence of HFT, and thus those concerns are not particular to HFT. There are, however, opportunities for regulators, HFT firms, and exchanges to continue to work together to monitor and develop internal and external “circuit breakers” and consolidated audit trails to ensure continued market stability and integrity.

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Introduction

High Frequency Trading (HFT) is a form of algorithmic trading in which firms use high-speed market data and analytics to look for short-lived supply and demand trading opportunities that often are the product of predictable behavioral or mechanical characteristics of financial markets. Also called “equity market making,” HFT firms usually hold their positions for less than a minute while perpetually looking for buy and sell opportunities.¹ These transactions happen thousands of times a day, take microseconds, and often net less than a penny in profit per share traded. HFT serves as a tool to facilitate market efficiency in informationally efficient markets.

This is an important time to discuss the role, if any, for U.S. regulators in monitoring or controlling HFT. Countries such as France and Germany have recently taken steps to significantly curtail or even ban HFT activities. Recently in the United States, the Securities and Exchange Commission (SEC) proposed additional regulation under a new rule called Regulation Systems Compliance and Integrity (“Regulation SCI”). This regulation seeks to “formalize and make mandatory many of the provisions of the SEC’s Automation Review Policy that have developed during the last two decades.”² Fortunately for HFT traders, according to Andrei Kirilinenko, former chief economist at the Commodities Futures and Trading Commission, the current proposal by the SEC aims “to take existing practices and make them federal regulations” rather than attempting to significantly curtail HFT market activity.³ Yet the move does signal a desire by U.S. regulators for an increased and more formalized regulation of HFT.

This paper discusses the role of HFT in generating informationally efficient markets. In particular, it examines how the changing velocity of information makes HFT an integral part of contemporary markets. It then explores the criticisms of HFT, including the potential for a two-tiered system, volatility, flash crashes, HFT’s role in market-making,

and concerns about market “noise” and integrity from an historical and contemporary perspective to determine if any of those issues are exclusive to HFT. The paper concludes with recommendations for the roles of regulators, the market, and market participants regarding HFT.

HFT in Informationally Efficient Markets

Financial markets are believed to be “informationally efficient.” This term comes from the efficient market hypothesis developed by Eugene Fama. The underlying concept of the efficient market hypothesis is that “no simple rule based on already published and available information can generate above-normal rates of return.”⁴ Fama describes the conditions facilitating market efficiency as “market[s] where there are a large number of rational profit-maximizers actively competing with each other, trying to predict future market values of individual securities, and where current information is almost freely available to all participants.”⁵ He describes an informationally efficient financial market as “a market in which prices always ‘fully reflect’ available information.”⁶ High frequency traders create a base of rational, profit-maximizing competitors that use available high-speed information to help determine the market value of individual securities.

In informationally efficient markets, HFT is a contemporary tool to utilize available information efficiently to value securities and execute trades in the market. When the efficient market hypothesis was developed, information was passed on relatively slowly as professional investors gathered around tables and examined quarterly and annual reports and painstakingly created hand-drawn charts of stock and market activity. HFT is a contemporary application of the same process that takes advantage of the increasing speed and quantity of data and the availability of computer algorithms that can quickly sort through and analyze the data.

Efficient markets rely on the efficient distribution of information. This information resides both inside and outside the market. Within the market, information is contained and reflected in the price of securities. Once outside information is known to at least one person, it begins to be reflected in the price of a security or the market as a whole. Microeconomic information influences the value of a security relative to another security, whereas macroeconomic information can influence the market value as a whole. HFT helps disseminate this information within markets quickly and efficiently.

The movement and symmetry of internal and external market information are not assumed to be perfect. As Fama states, it is “almost freely available.” One of the early notable contributions to the field of market efficiency includes a paper published in 1921 by F. W. Taussig, in which he observed that financial markets seem to diverge from the ordinary reasoning of supply and demand as they are subject to manipulation based on information that may not be widely known.⁷ He observed that technical information—such as whether a position is oversold or undersold—and insider information and rumors all led to fluctuations not anticipated by supply and demand alone. In other words, information (and anticipated information) influences market prices more quickly than traditional models of supply and demand would forecast. This is in part due to the fact that information cannot be supplied to everyone at exactly the same time. Asymmetric information in informationally efficient markets is not a new concept.

Price changes serve as an efficient way to disseminate information, even when everyone may not immediately know the specific information. In this way even private information begins to be reflected in prices well before it becomes news. Often by the time information is made public, price changes have already been made. Paul Samuelson observed that markets are so informationally efficient that by the time an individual expects a price to rise, it has already risen.⁸ When the Federal Reserve announces interest rate changes, for

example, the market has often already adjusted prices based on the anticipated news derived from other economic indicators. Falling prices usually indicate negative information and rising prices indicate positive information. Dimson and Mussavian provide a more contemporary version of Fama’s definition by describing market efficiency as “used to describe a market in which relevant information is impounded into the price of financial assets.”⁹ HFT helps facilitate this process.

The Changing Nature of Information in Efficient Markets

Financial market efficiency has been described in many ways, including “rational,” “a fair game,” “a random walk,” and “unbeatable.”¹⁰ However, one common element in all efficient market theories—including those that claim markets are inefficient—is the use and impact of information on markets. The HFT debate is no exception. The key characteristic that differentiates HFT from other types of information dissemination is the velocity of that information. When much of the iconic literature that guides our markets was written, information moved relatively slowly, as a review of the history of the efficient market hypothesis reminds us. As a result, the analysis of the role of information was very static in nature and focused primarily on intrinsic microeconomic factors like dividends, price to equity ratios, corporate leadership structures, and risk mitigation through portfolio diversification.

Since that time, the velocity of information—defined as the rate at which information moves through the market—has increased exponentially. This has created a need for market analysis to be both faster and more dynamic. The development of HFT is both a result of, and a contributor to, this high-velocity information environment. The Internet, social media, computerized trading platforms for amateur investors, the 24-hour availability of news, the global economy, and the fact that 401(k)

High frequency trading facilitates the dissemination of price change information, allowing even private information to be reflected in prices well before it becomes news.

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investment decisions are increasingly in the hands of ordinary citizens all contribute to the changing velocity of information and the increasingly dynamic nature of markets.¹¹

It is important to note that the speed of information in the market is not likely to continue to increase at the same exponential rate we have observed in the recent past. At some point, the marginal cost of the technology that allows HFTs to continue to take advantage of smaller and smaller fractions of a second becomes greater than the marginal benefit of that technology. Even market speed is subject to the limitations of marginal cost/marginal benefit analysis. There is evidence (discussed in the following section) indicating that HFT may be close to reaching its maximum market velocity when utilizing current technology.

Beating the Market?

As long as there have been financial markets, there have been investors trying to “beat the market.” Often these attempts include taking advantage of information that others don’t have. The efficient market hypothesis suggests that these “informational inequities” are short-lived. The informational inequities leveraged by earlier adopters of high frequency trading appear to be no exception.

The motivation for HFT is using technology to take advantage of high-velocity information in the market. By utilizing computer algorithms, traders have been able to take advantage of lags of microseconds in trading information, both to increase liquidity and to make a very small profit per share. In any market where there are profits to be made, there is incentive for additional competitors to enter the market. Using data from the New York Stock Exchange, we see that high frequency trades flooded the market between 2005 and 2009, as their daily trading volume skyrocketed 164 percent and accounted for 61 percent of the New York Stock Exchange trading volume in 2009, according to Tabb Group, a research and strategic advisory firm.

In efficient markets, the types of informational gaps that lead to significant profits are short-lived. This has proven true with HFT as well. New competitors will continue to enter a market until profits approach zero and this appears to be happening with HFT. With the explosive growth of HFT and algorithmic trading in general, the speed of the market has increased for everyone, making it difficult to take advantage of microsecond gaps in information. The result has been a decrease in daily trading volume done by HFTs from the 61 percent high in 2009 to 51 percent in 2012. Profits from HFT have also decreased substantially from a high in 2009 of \$7.2 billion to only \$1.8 billion in 2012.¹²

The market has done a very good job of managing the proliferation of HFT and rebalancing information availability as the pace of the market and its informational inputs have “sped up” for everyone. Yet there remain critics of HFT who insist that additional aggressive regulation is the only way to ensure ongoing stability and integrity in the market. It is interesting to note that most of these concerns are not new. Those who wish to try to regulate volatility, “fairness,” and potential informational inequities have been asking for this intervention long before HFT. However, in any market, it is impossible to regulate risk and uncertainty away or ensure that information reaches everyone at the same time. The discussion that follows highlights some specific areas of concern for those who oppose HFT and how the market is handling those issues.

Two-Tiered Market System. Some critics of HFT are concerned that an increase in algorithmic trading will lead to a two-tiered market system, with large brokers utilizing HFT operating on one tier and everyone else on another. But this is no new problem created by HFT; there have always been asymmetries in the information available to large firms with significant resources compared to individual investors. Even at a time when information was disseminated relatively slowly, individual investors did not have the resources to conduct the daily analysis necessary to keep them as informed as their professional

counterparts. The informational challenges facing individual investors were the motivation for a Boston stockbroker to establish the Massachusetts Investors Trust, the first open-ended mutual fund.¹³ Mutual funds allowed individual investors to take advantage of professional management and minimize informational gaps.

While individual investors do not have access to the microseconds of insider information contained in the algorithms used in HFT, far more information is available to even retail investors in contemporary markets than was the case 20 years ago. An individual can now trade securities from his or her laptop at the kitchen table and can get up-to-the-minute information on prices and trading volumes—evidence of the improved accessibility of information. Access to near-real-time market data and computerized trading has improved information symmetry, with 99 percent of brokerages reporting executed transactions within 10 seconds.¹⁴ Additionally, for a fee, sponsored access and colocation programs are available to anyone who wishes to have direct high-speed access to markets. But for most individual long-term investors, the strategy remains the same as it was in prior decades: contribute monthly to one or more mutual funds and hold them. In contrast, the strategies employed by HFTs involve significant risks that are not appropriate for most small retail investors. For parties involved in HFT, however, efficient markets reward those risks.¹⁵

A recently discovered loophole in the Chicago Mercantile Exchange's (CME) computer system allowed traders to "detect when their own orders for certain commodities are executed a fraction of a second before the rest of the market sees that data," thus giving HFTs an opportunity to determine the direction commodities will be moving and allowing them to structure orders to tip the direction prices for those commodities move. This flaw was self-reported and not detected by a regulator. In response to this disclosure, Charlie Munger, vice chairman of Berkshire Hathaway, described HFT as "legalized front-running."¹⁶ Yet it appears only a small number of firms were aware

of the CME delay and took advantage of it. The CME's public disclosure of the loophole automatically removes the advantage enjoyed by those who were aware of it. They will also be implementing a computer fix to eliminate the delay. This is one more example of how market participants are working to manage informational inequities inherent in any market.

Volatility. In 1927, long before the development of HFT, Frederick C. Mills observed market volatility in the form of overreactions and overcorrections. He found that stock prices move somewhat randomly most of the time, but noted that when the price of a stock starts to move suddenly in one direction, it moves much further and faster than would be expected.¹⁷ Werner F. M. DeBondt and Richard Thaler found that stock traders tend to overreact to unexpected news and information, and weight the most recent information more heavily, frequently ignoring even the prior day's news. This is especially true if the current news is unexpected or dramatic. This overreaction leads to an overcorrection, resulting in a significant price swing in the opposite direction.¹⁸

A 2006 study by Stefan Gerlach, Srichander Ramaswamy, and Michela Scatigna conducted a review of 150 years of financial data from around the world and found stock market volatility is highest during episodes of economic and political turbulence and exacerbated during periods of war. Again, many of these observations were made before the development of HFT. While we saw increased and relatively sustained volatility in the U.S. financial markets between October 2008 and September 2011, it was more likely the result of economic turmoil from the subprime mortgage crisis and resulting insolvency of many large financial institutions than a result of the rise of HFT. This is demonstrated by the reduction in volatility in the market today as economic indicators suggest the economy is improving. HFT continues to be conducted in this less volatile market environment, even with no significant changes to the regulatory environment, indicating that HFT has little or no impact on market volatility.

With the algorithms used in high frequency trading, far more information is available to retail investors today than was the case 20 years ago.

Retirement savings investment decisions made by retail investors in times of economic and political turbulence [also] contributes to increased market volatility.

Another non-HFT factor that may contribute to increased volatility of contemporary markets during times of economic and political turbulence is the increasing number of investment decisions being made by retail investors as they invest their retirement savings through 401(k)s and other vehicles. When the efficient markets hypothesis was developed, much of the investing was conducted by professional investors and often involved investing companies' pension funds for defined benefit pension programs. As discussed earlier, nonprofessional investors do not have the access or time to analyze microeconomic company or even mutual fund information because of the large number of options available today. As a result, they tend to rely on macroeconomic information to make investment decisions. Macroeconomic information generally has greater velocity and tends to be "sentiment" information, generating emotions like fear or optimism. Macroeconomic information includes factors such as high unemployment rates, falling housing prices, income, wealth, budget deficits, sovereign debt crises, and concerns about national debt—topics that are repeatedly broadcast in the news and that impact individuals' own lives. During times of optimism about these macroeconomic factors, retail investors are likely to take on more risk and invest more, and during times of uncertainty they may pull back from the market. The inability of these investors to analyze large amounts of microeconomic information means they avoid adjusting their portfolios for risk and tend, instead, to be either "all in" or "all out" of the market. This trend was evident in the first seven months of 2010 when investors withdrew \$33.12 billion from mutual funds in the domestic market and treasury rates hovered around zero as investors fled the market.¹⁹ When this occurs, market prices are subject to changes based on shifts in supply and demand for market securities as a whole.²⁰ Volatility, including overreactions and overcorrections, is not new, but the introduction into the market of more active nonprofessional investors, who invest based on macroeconomic rather than micro-

economic concerns, does create opportunities for more pronounced volatility during difficult economic and political times. In this situation, HFT may help to provide some stability in market prices.

Flash Crashes. During the Flash Crash of May 6, 2010, the Dow Jones Industrial Average fell more than 600 points (about 6 percent) in a matter of minutes, although it then regained that amount within the next half hour. Because HFT pulled back from the market during the drop, some commentators argue that this collective action was the cause of the flash crash. However, a joint report by the SEC and Commodities Futures and Trading Commission determined that the mutual fund firm Waddell and Reed's sale of 75,000 "E-Mini" contracts (for S&P stock futures worth \$4.1 billion) in 20 minutes during an already stressed market precipitated the flash crash. According to the report, this trade was one of

the largest net change in daily position of any trader in the E-Mini since the beginning of the year. . . . Only two single-day sell programs of equal or larger size, one of which was by the same large fundamental trader, were executed in the E-Mini in the 12 months prior to May 6. When executing the previous sell program . . . it took more than 5 hours for this large trader to execute the first 75,000 contracts.²¹

Whether Waddell and Reed's trading strategy that day was intentional or accidental is unclear. However, what is relevant for the purposes of this discussion is that the joint report specifically states that HFTs actually assisted the market by absorbing some of the initial sell pressure, but then began selling quickly themselves as prices dropped, as would be expected of any investor holding a toxic asset. Trading was initially paused and when it resumed the market recovered quickly—assisted by HFT.

This is consistent with an analysis of Eurex, the derivative exchange owned by Germany's Deutsche Börse. According to Ran-

dolf Roth, Head of Eurex's Market Structure division, "HFT firms contribute not only to liquidity but also help in severe situations to stabilize the market by continuing to run their algorithms the way they did before."²² It is only under extreme conditions that HFT appears to pull back from the market.

There is also evidence to suggest that these short-term crashes are a generic feature of equity markets and not the result of HFT. In a recent paper, Columbia Business School professor Charles M. Jones argues that such crashes were common long before the advent of HFT. He points to the crash of 1987, in which stocks lost more than 20 percent in one day, as well as a similar crash in 1962. He notes that during the 1962 crash "specialists on the New York Stock Exchange floor stepped aside or actively sold shares as stocks plummeted as much as 9 percent in 12 minutes."²³ HFT does not appear to contribute more to this destabilization during market crises than manual trading. During the Flash Crash of 2010, the decision of HFT to subsequently pull back from the market was a symptom of the problem and not the root cause.

The 2010 Flash Crash also raises a number of potential nonregulatory solutions for preventing such events in the future. One measure that shows some promise in predicting and preventing future flash crashes is the volume-synchronized probability of informed trading (VPIN).²⁴ The metric is designed to measure "order flow toxicity," a situation that occurs when there are so many buy and sell orders for a security that it becomes impossible to match all the orders.²⁵ In cases like these, participants in HFT will often stop supplying liquidity in an attempt to prevent losses. This type of activity is what precipitates a flash crash. By monitoring market activity using volume-synchronized probability of informed trading, traders and regulators can be warned of an imminent flash crash, giving them the opportunity to trigger voluntary trading slow-downs or halt trading altogether.

Exchanges in the United States have already taken voluntary measures to minimize

extreme trading volatility. These "circuit breakers" monitor activity and curb trading if the average price of a stock moves 5 percent, 10 percent, or 20 percent above or below the preceding five-minute average. HFT sets risk limits that serve as human-initiated circuit breakers if either extreme price changes or buying and selling activity is observed. The desire for market efficiency provides incentives for exchanges and HFT participants to maintain market stability and organization because without this there would be chaos, which undermines efficiency.²⁶ A chaotic environment does not benefit any market stakeholders, including participants in HFT.

Market Liquidity. One of the greatest benefits of HFT is that it results in improved market liquidity and reduces costs to investors. HFT improves liquidity by reducing spreads through "market making," a function whereby HFT participants act as intermediaries to keep liquidity moving through the market. Buy and sell orders are not always placed simultaneously. If an investor wants to sell immediately at a specified price, there may not be a buyer available. This forces the seller to hold the security longer than he would like while he waits for a buyer. In this case, HFT adds value to the market because HFT participants are able to buy the security at the point in time when the seller wishes to sell and then sell that same security to another buyer when she enters the market. This reduces spreads and increases market liquidity. As discussed in the previous section, HFT is sometimes accused of creating market volatility, but in reality it assists in stabilizing short-term prices by eliminating gaps that would otherwise exist when buyers and sellers are not active in the market at the same time.²⁷ In addition, HFT's role in reducing bid-ask spreads has also reduced trading costs. According to data from the Financial Information Forum, the average cost of trading one share of stock was reduced from 7.6 cents in 2000 to 3.8 cents by the second quarter of 2012.²⁸ It is also important to note that the Dodd-Frank Wall Street Financial Reform and Consumer Protection Act's so-

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called “Volcker Rule” may well affect significantly the ability of traditional commercial and investment banks to engage in market-making activities because of the associated uncertainty about the rule and compliance costs. This reduction in bank-sector market-making capacity would make the market-making function of HFT participants even more critical for market efficiency.

Attempts by regulators to slow the market down by forcing intermediaries to hold a security for a specific period of time, charge a transaction fee, or lower cancellation ratios will only create market distortions that will ultimately harm all investors and raise the costs of trading. An investor providing liquidity will simply widen his spreads to compensate for the greater risk and pass this cost along to customers in the form of higher fees. In both cases, liquidity decreases and costs to investors increase, resulting in an overall decrease in market efficiency.²⁹

Noise and Market Integrity. Critics often cite “market noise” as a negative, and possibly even illegal, outcome of HFT because it harms market integrity. Market noise exists when competing and/or contradicting information exists or when the amount of information becomes too great for the market to process.

The existence of competing and contradictory information is not new to financial markets and predates the emergence of HFT. Taussig noted as early as 1921 that insider information, rumors, and technical knowledge held by some professionals cause markets to act in ways we would not expect based on supply and demand for securities alone. Markets are affected by this noise even when the velocity of information is relatively slow. A study by Fama found that market participants anticipate information and adjust prices based on this noise before it becomes known to the general public, indicating many of the buy and sell decisions in financial markets are based on expectations.³⁰ The expectations about future prices compete with current information in financial markets.

The noise in contemporary markets is largely the result of the high-velocity infor-

mation environment discussed earlier and would exist with or without HFT. Yet HFT can contribute to market noise, as algorithms test bids for price points and then cancel orders. Some algorithms create noise by rapidly submitting or canceling orders in an attempt to ignite market momentum, a practice that some have argued may deserve scrutiny by regulators. Much of this type of noise is created when HFT participants are trading with other HFT participants. However, as these methods have become more commonly understood, they are becoming less effective. Algorithms have been developed that attempt to detect market noise created by HFT, thereby allowing other algorithms to ignore it, minimizing its effectiveness as an igniting strategy. In other words, algorithms are becoming better consumers of market information created by other algorithms, and regulators are adopting appropriate restraint by allowing the competitive market to control those who may be exploiting algorithmic systems through disinformation.

Brokerages are also taking steps to police their own environments. “Dark pool” trading platforms, where electronic trading occurs within a network rather than on transparent exchanges run by HFT and other participants, have fallen under the same scrutiny and are subject to similar calls for regulatory action. Dark pools run by banks such as Barclays, Bank of America, Credit Suisse, Deutsche Bank, Royal Bank of Scotland, and others have found ways to successfully internally manage risk and noise. These banks monitor their networks for “unwelcome trading behavior.” When such behavior is detected, the perpetrators are asked to modify their practices or leave the network. Barclays is taking this process one step further by making the results of their monitoring available to their clients, disposing of the anonymity that is usually associated with dark pools in a move that will encourage other companies to follow suit. This will allow participants in the network to see whether other participants in the network are typically passive, neutral, or aggressive traders, thereby allowing these

participants to determine with whom they would like to trade. Barclays has found that by sharing information, clients “tend to develop [a] trading flow that more frequently fits the passive and neutral profile and that falls less and less in the aggressive camp, making the dark pool venue a better experience for everyone.”³¹ Market participants are therefore creating their own boundaries and standards to maintain a robust and healthy market environment.

There are still legitimate concerns that some activities initiated by HFT violate existing SEC regulations. If that is true, then the penalties associated with violating these existing regulations need to be enforced against the HFT outfits that violate them. This requires enforcement of existing regulations and does not require new or additional regulatory action. Another concern is that as an increasing number of traders gain direct high-speed market access, the potential threat of “weaponized” algorithms (used by terrorist groups and aimed at harming U.S. financial markets) also increases. However, the SEC minimized this risk in 2010 by requiring brokers and dealers who provide sponsored access to an exchange or alternative trading system to provide only filtered access to third-party traders and subject them to the risk-management controls and supervision of the broker-dealer.³²

The key issue for regulators is to be careful to distinguish between inappropriate uses of a technology (such as order ignition, intentional quote stuffing, wash trades, and other manipulative practices) and the technology itself. As discussed earlier, developing additional regulatory requirements that restrict the activities of all high frequency traders will likely create market distortions and disrupt the efficient movement of market information, liquidity, and short-term price stability. This is likely to be more damaging to the market than HFT-induced noise. Regulatory agencies have typically had difficulty monitoring illegal activities because they have lacked the technology to adequately monitor contemporary markets. This is one area in which improvements can be made, but since

this is an institutional problem rather than a legal problem, it does not require enhanced or additional regulation of HFT.

Conclusion

HFT is a contemporary tool of efficient markets in a high-velocity information environment. The concerns many have about HFT—asymmetric information, volatility, flash crashes, and noise and market integrity—are neither new to financial markets nor exclusively associated with HFT. In addition, HFT is being effectively regulated, in large part, by the market and its participants. As the speed of information dissemination in the market has increased for everyone, decreasing profit potential has controlled the proliferation of HFT. The economic constraints of marginal costs and marginal benefits mean that HFT activity appears to have peaked given current available technology, and enhanced algorithms and internal monitoring have minimized inefficiencies created by market noise. Computerized trading systems, increased availability of direct high-speed market access, and decreasing reporting times on executed transactions have decreased informational asymmetries for all market participants. HFTs have improved efficient use of information in the market by improving liquidity, creating cost savings for investors, and reducing short-run volatility.

Notes

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3. See E. D. Melendez, “SEC Proposal to Curb High-Frequency Trading Falls Far Short of Goal: Industry Experts,” *Huffington Post*, March 12, 2013, http://www.huffingtonpost.com/2013/03/12/sec-high-frequency-trading_n_2853004.html#share_ended.

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