TRADING IN THE 21ST CENTURY:

An Investor Perspective

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I. Foreword

by Richard H. Baker

Whether you pay bills online, get travel directions on your smart phone or book a restaurant reservation with the latest app, technology has had a profound impact on nearly every aspect of our lives. Errands that used to consume a Saturday morning can now be completed in a matter of minutes. In addition to saving time, many of these technological leaps have also allowed consumers to save money by eliminating the middle-man.

This automation is a result of living in a modern, technologically advanced society – and the benefits automation provides are only growing. In the U.S. and beyond, market participants are using computers and automation in increasingly sophisticated ways. In fact, technology has so altered financial markets that the world's largest futures-market operator closed its main trading pits because in-person trading amounts to just one percent of all daily contracts.

Computers are now as important for trading as the stock exchange floors you see on the nightly news once were.

The evolution of technology in this electronic age is generally welcomed by consumers and businesses. Yet, there remains some suspicion when we apply these same concepts to stock or commodity derivatives trading.

Our latest paper, "Trading in the 21st Century: An Investor Perspective," takes a look at this phenomenon and how it has developed over the last few decades. It explores the different categories of automated trading, the purpose or function of each and, importantly, the regulatory oversight to which it is subject. The paper also details how trading costs have decreased and market efficiency has increased in recent years, and the important role technology and automated trading have played in bringing about each of these changes.

We hope you find this paper both informative and insightful.

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II. Executive Summary

Global financial markets have evolved substantially due to the rapid pace of technological advances and regulatory changes over the past few decades. Technology has made regular activities, such as purchasing movie tickets, selling memorabilia, sending correspondence and banking more efficient. Similarly, trading in financial markets has dramatically improved with increased automation to help make investing more accessible and affordable.

Nevertheless, automated or algorithmic trading is still often regarded by many with apprehension and suspicion, rather than an appreciation for the benefits that investors of all stripes have derived from advances in trading technology.

This paper provides some historical background on the development of electronic trading generally, and explains how trading algorithms are used by managers of private funds and other institutional investors. We believe these perspectives are important to consider as policymakers evaluate how to ensure that the regulatory oversight and market structure keep pace with evolving markets and technology.

As policymakers and regulators evaluate potential measures to regulate electronic trading, they should understand that investors may use trading algorithms in different ways than banks, brokers, market makers or other intermediaries. As a result, when it comes to such regulatory requirements, one size may not fit all.

Key Takeaways

This report examines the evolution of financial markets in the modern era. The following key takeaways provide a brief overview of the impact automated trading has had on our markets, the benefits it has provided investors and current regulatory oversight.

- Automated trading has helped lower costs for investors. Before orders could be submitted electronically, investors had to rely on brokers for trading and liquidity. Execution fees were significantly higher, often making trading more cumbersome and expensive.
- Automated trading has made markets more efficient. New market structure regulations and the use of technology have worked together to enhance market liquidity and to lower transaction costs.
- U.S. and European regulators and exchanges have enhanced electronic trading regulations and closely oversee trading, including automated trading practices.
- The terms “automated trading” and “algorithmic trading” have become catchall terms. But it is important to understand that there are widespread uses for automated trading and not all automated trading is the same – therefore regulations should not be imposed in a “one size fits all” fashion.

III. Background: Modernization of the Markets

Before buy and sell orders could be submitted electronically and matched by computers as they are today, investors had to contact a broker, usually by telephone or in person. These brokers would typically execute orders manually or route them to market makers on exchange floors, like the New York Stock Exchange (NYSE). With only a few leading market centers competing for orders and the need to rely heavily on firms acting as market makers to fill them, bid/offer spreads were much wider and execution fees were significantly higher than they are today. Trading was both inefficient and expensive – and these costs were borne by investors.

In the past five decades, regulatory and technological changes have helped spur competition and propel changes in market structure.[1] Trading began shifting from primarily floor-based trading pits to electronic marketplaces. More than 40 years ago, Nasdaq began trading in 1971 as the world's first electronic stock market, trading over 2,500 securities.[2] In 1978, the Chicago Board Options Exchange automated order-routing and limit order book access.[3] In 1986, the London Stock Exchange moved from floor trading to computer and telephone trading.[4] In 1992, the CME Group launched the first electronic futures trades on CME Globex, an electronic trading platform. [5]

Advancements in computing technologies made computers more affordable and practical for personal and business use. Along with the move towards computerization and electronic trading, breakthroughs in mathematical/quantitative modeling of financial markets laid the foundation for modern quantitative financial analysis and spurred the use of algorithms and automation in trading.[6] Together, these developments revolutionized the financial marketplace. The markets became accessible to a broader group of market participants as electronic trading was not restricted by exchange membership and the physical confines of a trading pit. More market participants, including brokers, proprietary trading firms and asset managers began to trade more actively. A growing number of automated or algorithmic traders were among those ranks. In fact, in many markets automated traders using algorithmic market making strategies have gradually replaced manual traders in providing market liquidity.

Throughout this financial marketplace evolution, market liquidity and transaction volume have grown while transactional costs have significantly decreased – all to the benefit of investors.

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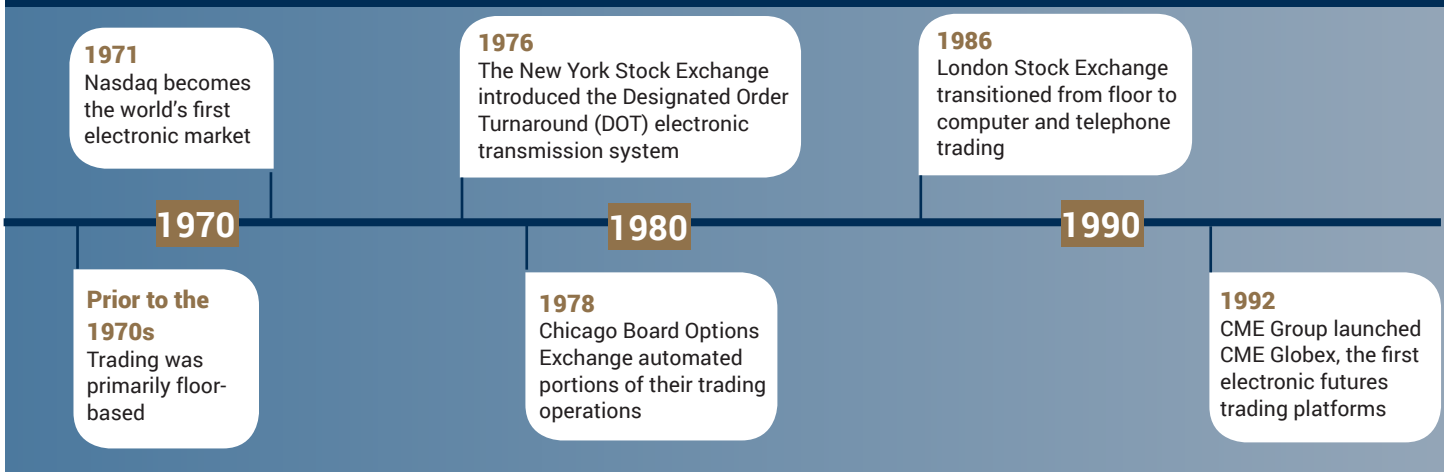
Key Dates in the Growth of Electronic Trading

Electronic markets have been in place for more than four decades. Regulations combined with the increase in automation have made trading less expensive and more efficient because investors no longer are solely reliant on middlemen to provide liquidity.



1 *See, e.g., SEC Order Handling Rules, SEC Regulation ATS, decimalization in the U.S. equity markets, and SEC Regulation NMS*

2 *Ellen Terrell, History of the American and NASDAQ Stock Exchanges, Library of Congress, Business Reference Services, available at: http://www.loc.gov/rr/business/amex/amex.html.*

3 *CBOE History available at: http://www.cboe.com/aboutcboe/history.aspx.*

4 *London Stock Exchange, Our History, available at: http://www.londonstockexchange.com/about-the-exchange/company-overview/our-history/our-history.htm.*

5 *CME Group, Timeline of CME Achievements, available at: http://www.cmegroup.com/company/history/timeline-of-achievements.html.*

6 *See discussion in Andrei A. Kirilenko and Andrew W. Lo, Moore's Law versus Murphy's Law: Algorithmic Trading and Its Discontents, 27 Journal of Economic Perspectives 2013, at p. 53, available at: http://www.argentumlux.org/documents/Moores_Law_vs_Murphys_Law_Spring_2013_JEP.pdf.*

7 *See, e.g., CME Group, Growth of CME Globex Platform: A Retrospective, available at: http://cmegroup.mediaroom.com/index.php?s=114&item=119. The CME Globex's "open access" policy led to enhanced liquidity, reduced costs and large-scale advances in volume.*

IV. Automated Trading: Widespread Uses

The terms "automated trading" and "algorithmic trading" have become catchall terms for any trading that uses computer programs or software. There are, in fact, different categories or functions relating to trading that have become automated. As policymakers and regulators reexamine regulation and oversight of financial markets, it is important to understand that there are widespread uses for automated trading and not all automated trading is the same. Thus, with respect to any requirements that are prescriptive in nature, one size may not fit all.

Generally, automated trading can be divided into two categories:

- Execution algorithms, which determine the most efficient method of buying or selling a security and then initiate the purchase or sale orders; and
- Investment algorithms, which are trading or investment software that analyze data to decide which securities to buy or sell.

Execution Algorithms

The development of electronic trading and the expanding network of exchanges and electronic marketplaces created the foundation for firms to create computer programs that automate the process of executing an order.

Today, pension funds, foundations, sovereign wealth funds, endowments, hedge funds, mutual funds, broker/dealers and other market intermediaries all use execution algorithms to buy or sell securities. Market participants use execution algorithms to efficiently and automatically determine the most cost effective manner to execute orders, including the optimal order size and best market and time to place orders. If a market participant simply sent a large order to a single exchange without using an execution algorithm, the order would likely face higher execution fees and move the price of the security against the market participant, substantially increasing overall costs.

Many investors use execution algorithms offered by broker-dealers rather than develop their own, whether or not, they develop their own investment algorithms. In these instances, investors enter into contractual agreements with their brokers much like how one enters into a contractual agreement with a mobile phone carrier or an internet service provider to use the broker's algorithm. While these investors are engaged in automated trading and responsible for using the service as contractually specified, they are not responsible for the testing, maintenance or upkeep of the algorithm any more than someone would be responsible for developing software updates to Apps on their smart phone. That's the job of the broker-dealers providing the execution algorithm.

Finally, some investors may use a combination of in-house and broker-dealers execution algorithms as a cost-effective strategy for trade execution of their investment decisions. An example would be using an in-house execution algorithm in U.S. equity markets but a dealer's execution algorithm in European markets.

Investment Algorithms

In addition to using execution algorithms, some market participants also automate their investment strategies, using computer models to sift through mountains of data quickly and accurately to decide which asset to buy or sell.

There is a broad spectrum with respect to how market participants deploy investment algorithms as part of their overall strategy. Some automate the process of identifying which securities to buy or sell and then leave the ultimate decision to an investment professional. Others automate the entire process. Whether partially or entirely automated, strategies also differ in investment duration – ranging from seconds and minutes to days, weeks and years.

Who Uses Algorithms: Retail and Institutional Investors

Many popular investment products commonly used by passive and retail investors rely on investment algorithms that adjust the portfolios in light of changes in securities prices throughout the trading day. This keeps the portfolios aligned with stated investment goals.

Algorithmic strategies are also used by more active investors that employ mathematical, statistical and computational modeling to analyze market and economic data, company filings and other information to detect investment opportunities for clients. These quantitative investment strategies are not conceptually different from traditional strategies where analysts pore through securities filings and other data to make investment decisions. In today's markets, with an abundance of data available electronically, computer models can analyze large amounts of data more efficiently and often in more detail than analysts.

> High frequency trading is a legitimate and beneficial trading strategy that should not be confused with the illegal activity of spoofing – a disruptive trading practice where a trader places bids and offers with the intent to cancel them before execution – or other types of manipulative trading.

These algorithmic strategies are developed using proprietary research that can be a firm's most important intellectual property. Similar to food and beverage companies that closely guard recipes and formulas, investment managers take extra precautions to protect their research.

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An algorithmic or quantitative approach to investing does not work for every type of security, financial product or strategy, so individual analysts are still critical to many mutual fund and hedge fund strategies. Passive, indexed and "quant" investment strategies, however, represent the largest part of the equity-investing universe for both retail and institutional investors.

Who Uses Algorithms: Market Makers, Brokers & Proprietary Traders

Brokers and other market participants, such as proprietary trading firms, employ automated market making or "high frequency trading" strategies that use algorithms to determine when and where to trade and the size and price of orders. Using techniques similar to manual market makers of years past, these firms use algorithms to manage inventory risk and earn profits from providing liquidity. High frequency trading is a subset of automated trading and includes both investment and execution algorithm components. It is generally employed by broker-dealers or proprietary trading firms, rather than investment managers or funds. Unlike advisers to mutual funds or hedge funds, these trading firms do not manage large pools of assets for investors. High frequency trading strategies are often defined or known as strategies that execute high volumes of transactions within short time intervals and end the day relatively flat with little to no securities on their balance sheets, unlike investment funds.

In the electronic trading era, brokers market makers and proprietary traders engaged in high frequency trading strategies have become the market makers and liquidity providers of today's markets.[8]

Key Terms

Market Makers: A broker-dealer firm that accepts the risk of holding a certain number of shares of a particular security in order to facilitate trading in that security. Each market maker competes for customer order flow by displaying buy and sell quotations for a guaranteed number of shares. Once an order is received, the market maker immediately sells from its own inventory or seeks an offsetting order. Source: Investopiedia

High Frequency Trading: A subset of automated trading and includes both execution and investment algorithm components. It is generally employed by brokers and proprietary trading firms rather than investment managers or funds. In the electronic trading era, brokers and proprietary traders using high frequency trading strategies have become the market makers and liquidity providers of today's markets.

Who Uses Investment Algorithms & How

INVESTOR TYPE	PRODUCT	HOW ALGORITHMS ARE USED
Retails and Institutional	Index Funds	The algorithm adjusts its purchases and sales of securities to follow the value of the index.
Retail and Institutional	Exchange-Traded Funds	Like index funds, ETFs use algorithms to match the fund's holdings to its investment targets.
Retail	Target-Date Funds & 130/30 Mutual Funds	Many of these investment vehicles use algorithms to help determine buy-sell portfolio rebalancing decisions.
Retail	Online Brokerage	After an investor enters his order to buy or sell securities, the broker's execution algorithm determines which market, when and in what size to send the order(s).
Institutional	Private Investment Funds	Mathematical, statistical and computational models are used to analyze market and economic data to determine investment opportunities.

8 See, e.g., Jonathan Brogaard et al., High Freque ncy Trading and Price Discovery, ECB Lamfalussy Fellowship Programme, 1602 ECB Working Paper Series November 2013, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1928510; Laurence Lescourret and Sophie Moinas, Liquidity Supply across Multiple Trading Venues, Working Paper №14-533, March 15, 2015, available at: https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxzb3BoaWVtb2luYXN8Z3g6NGQ3ODI3N2ZjYWEyNWIyNA; and Albert J. Menkveld, High Frequency Trading and the New-Market Makers, 16 Journal of Financial Markets 2013, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1722924.

V. Investor Benefits of Automated Trading

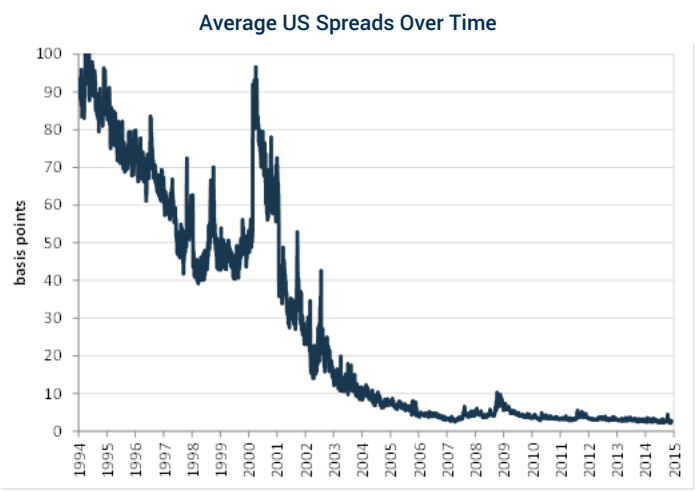
Regulatory changes over the last several decades have fostered innovations in technology – including automated trading – and promoted greater competition among marketplaces. Institutional and retail investors have been empowered with more efficient methods to access the markets and execute their investment strategies globally. Whereas markets used to be limited by the size of the trading pits and exchange memberships that were priced at the highest bid, regulations opened the door to greater competition and technology democratized the markets by making information more readily available. Competition and technology have made investing more accessible to every kind of investor.

In the U.S. equity markets, as a result of market structure and trading changes over the last 25 years, bid-ask spreads, fees, execution speed, efficiency and pricing transparency/reliability have steadily and drastically improved.

The following sections provide data showing how costs to investors have fallen and liquidity, or the ability to buy or sell a security, has improved.

Bid/Ask Spreads Have Fallen By 95%

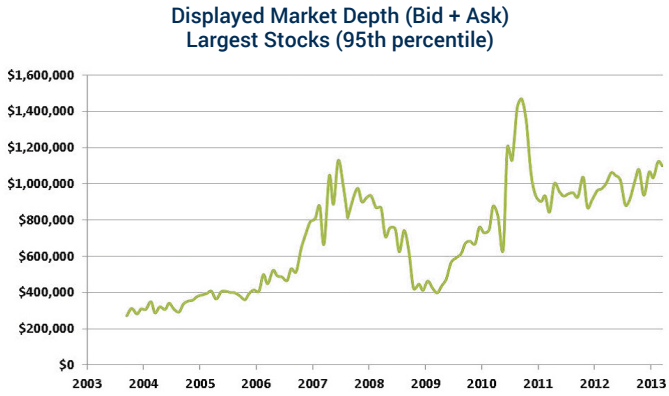
This chart shows a dramatic decline in average U.S. spreads since 1994. The quoted spread – the difference between the bid and the offer, or the price at which an investment is bought and sold – is a useful metric for comparing transaction costs for investors.



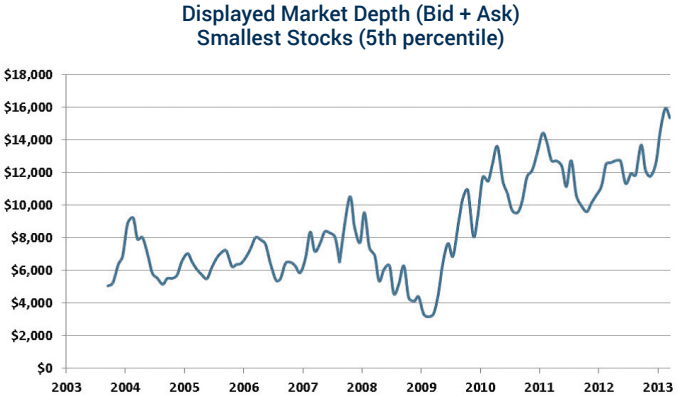
Source: Credit Suisse

Liquidity Has Improved Dramatically

The two graphs below show that market depth for large and small securities has been trending upwards. Market depth, a measure of liquidity, is measured by the volume of a security that is displayed on the bid and offer. It is often used as a metric when discussing market quality.



Source: James J. Angel et al., Equity Trading in the 21st Century: An Update, June 21, 2013, available at: http://www.q-group.org/wp-content/uploads/2014/01/Equity-Trading-in-the-21st-Century-An-Update-FINAL1.pdf (hereinafter "Angel et al.").



Source: Angel et al.

VI. Regulatory Oversight

Regulatory changes have been critical to promoting competition and the introduction of technology to the financial markets.

In addition to the market oversight and enforcement role that regulators have performed, policymakers and regulators have taken a number of steps in recent years to enhance regulations. Exchanges, in competing with other marketplaces, continually update their technological capabilities, and have been proactive in adopting new rules and implementing measures to enhance the safety and soundness of their financial marketplaces. Finally, regulators and exchanges, armed with advanced computing technologies are able to quickly and more readily identify possible instances of wrongdoing, continue to vehemently prosecute them and take enforcement action against market manipulators.

Policymakers and Regulators

Over the past few years, the U.S. Securities and Exchange Commission (SEC), on its own and in coordination with exchanges, has fine-tuned automated circuit breakers; implemented price collars to limit market disruptions; adopted a market access rule requiring broker-dealers to manage the risks of automated systems for accessing markets; established clearer rules for canceling trades; banned stub quotes (offers to buy or sell a security that are not intended to be executed because they are so far away from the prevailing market); and, adopted Regulation SCI to address the strength of critical market infrastructure in order to reduce the occurrence of systems issues and to improve resilience when systems problems do occur.[9] The SEC continues to work on enhancements to critical market infrastructure, such as consolidated market data plans and rulemakings on risk management of trading algorithms, transparency of alternative trading system operations, broker-dealer routing practices for institutional orders and an anti-disruptive trading rule, among others. [10]

The U.S. Commodity Futures Trading Commission (CFTC) has adopted rules requiring certain registrants to automatically screen orders for compliance with risk limits if they are automatically executed; issued a concept release on risk controls and system safeguards for automated trading, and conducts regular testing of trading programs.[11] The CFTC is considering additional regulations, such as registration requirements for proprietary traders with direct electronic access to a trading venue engaged in algorithmic trading; enhancing requirements with respect to pre-trade risk controls, and the need for standards on the development and monitoring of algorithmic trading systems, among others.

In Europe this past year, the European Union adopted Markets in Financial Instruments Directive II and Markets in Financial Instruments Regulation (MiFID/MiFIR), which include legislative provisions addressing algorithmic, high frequency trading and other market structure issues. On September 28, 2015, the European Securities and Markets Authority (ESMA) issued to the European Commission final draft regulatory technical standards for the implementation of MiFID/MiFIR, including organizational requirements for investment firms engaged in algorithmic trading (e.g., business continuity arrangements, testing of algorithms and systems, monitoring and review of algorithms, pre-trade and post-trade controls, etc.) and market structure issues (e.g., direct market access, pre and post-trade controls, dark liquidity, etc.).[12] The European Commission is expected to publish final delegated acts (legislative requirements) with respect to MiFID/MiFIR in 2016 and European Union member states are expected to apply MiFID/MiFIR delegated acts by January 3, 2017. Some states, such as France and Germany, have already passed and implemented legislation and regulations on algorithmic and high frequency trading in advance of national legislation adopting MiFID/MiFIR.

In 2012, ESMA published "Guidelines on systems and controls in an automated trading environment for trading platforms" and in March 2015 ESMA published findings from its peer review among National Competent Authorities with respect to the Guidelines. From the peer review, ESMA concluded that the competent authorities in Belgium, Denmark, Germany, Spain, France, Finland, Ireland, Italy, Netherlands, Portugal, Spain and the United Kingdom had achieved an adequate level of supervisory convergence on the Guidelines. [13]

Exchange Regulation

Exchanges, subject to oversight by government authorities, generally have regulatory oversight responsibilities with respect to their marketplaces. They routinely investigate questionable trading activity and contact market participants regarding, for example, unusually high order cancellations, position accountability thresholds or disruptive or manipulative trading. As a result, exchanges have implemented various measures and offer mechanisms to manage and mitigate market risks. These measures and mechanisms include circuit breakers, price collars, mechanisms to prevent orders at clearly erroneous prices, protection points for market and stop orders, credit controls, kill switches, cancel on disconnect protections, self-match prevention, and pre- and post-trade controls, among others.

9 Optimizing Our Equity Market Structure, Opening Remarks at the Inaugural Meeting of the Equity Market Structure Advisory Committee, Chair Mary Jo White, SEC, May 13, 2015, available at: http://www.sec.gov/news/statement/optimizing-our-equity-market-structure.html.

10 Id.

11 Remarks of Chairman Timothy Massad before the Global Exchange and Brokerage Conference (New York), June 3, 2015, available at: http://www.cftc.gov/PressRoom/SpeechesTestimony/opamassad-24.

12 See ESMA Readies MiFID II, MAR, and CSDR, September 28, 2015, available at: https://www.esma.europa.eu/news/ESMA-readies-MiFID-II-MAR-and-CSDR?t=326&o=home.

13 Automated Trading Guidelines, ESMA peer review among National Competent Authorities, ESMA/2015/592, 18 March 2015, available at: http://www.esma.europa.eu/system/files/esma-2015-592-automated_trading_peer_review_report_publication.final_.pdf.

VII. Conclusion

Electronic marketplaces dominate the financial landscape and all types of investors engage in automated trading. In fact, automated trading has become as commonplace – if not as mainstream – as booking travel reservations online.

Over the last five decades, technology and automation have brought significant benefits to investors, including greater accessibility, lower transaction costs and fairer markets. Financial markets continue to evolve and grow, raising essential capital for businesses to expand, providing a means for farmers and other commercial enterprises to hedge risk and offering important sources of investment income for institutional and retail investors.

Investors appreciate the diligence with which policymakers and regulators are reviewing and evaluating the adequacy of existing regulations for the markets. All market participants must, however, continue to be vigilant and dedicated to correcting issues before they become market-wide problems.

Almost all investors use automated trading strategies in one way or another, but they use them differently than banks, broker-dealers or market makers. So, when it comes to regulation, one size may not fit all. Regulation should be proportional, foster innovations in technology and promote greater competition among marketplaces – allowing investors to continue reaping the benefits of modern markets.

Almost all investors use automated trading strategies in one way or another, but they use them differently than banks, broker-dealers or market makers. So, when it comes to regulation, one size may not fit all. Regulation should be proportional, foster innovations in technology and promote greater competition among marketplaces – allowing investors to continue reaping the benefits of modern markets.

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