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Principal Traders Group
European Principal Traders Association

August 12, 2011

Mr. Werner Bijkerk
International Organization of Securities Commissions (IOSCO)
Calle Oquendo 12
28006 Madrid
Spain

Dear Mr. Bijkerk,

The Futures Industry Association (FIA) Principal Traders Group and FIA European Principal Traders Association appreciate the opportunity to comment on the IOSCO Consultation Report on *Regulatory Issues Raised by the Impact of Technological Changes on Market Integrity and Efficiency* (the "Consultation Report").

The Consultation Report provides a thorough analysis of many of the developments in market structure that are dramatically changing the way investors and liquidity providers access and trade the markets. Members of the U.S. FIA Principal Traders Group and the FIA European Principal Traders Association ("FIA PTG/EPTA") collaborated on the attached response, which comments on the observations in the Consultation Report and responds to select questions posed therein. FIA PTG/EPTA membership includes more than 40 European and U.S. principal trading firms that represent a major part of the volume on listed markets globally.

Principal traders have a vested interest in well regulated markets and strongly support initiatives to provide regulators with the necessary tools to detect, deter and enforce fraudulent and manipulative behavior. FIA PTG/EPTA also supports the deployment of robust risk management controls by participants, clearing firms and exchanges to protect the stability and integrity of the markets. Our members strongly believe that market integrity is not the exclusive responsibility of any one group of market providers or participants. Rather, exchanges, clearing firms, trading firms, and regulators each have a role in ensuring fair and orderly markets. As noted in more detail in our response, proposed regulations and market structure reforms should carefully leverage the strengths of these constituencies.

As IOSCO develops recommendations in response to the G20 mandate, we believe it is important to recognize that technology has leveled the playing field for market participants and provides a much higher degree of transparency for surveillance than historically available when the execution venue was a trading floor. Although certain market structure refinements may be appropriate, the benefits of electronic trading—increased transparency, greater liquidity, tighter

spreads, and reduced costs—should be recognized and must not be sacrificed. Academic and industry research overwhelmingly support the important role of electronic liquidity providers in today's marketplace including those who employ tools such as algorithmic and high-frequency trading. We caution regulators against basing regulations on evidence that is merely anecdotal.

We would be happy to provide additional information as needed.

Respectfully submitted,

Donald Wilson	Remco Lenterman
Chairman	Chairman
FIA Principal Traders Group	FIA European Principal Traders Association

Principal Traders Group
European Principal Traders Association

FIA Principal Traders Group and FIA European Principal Traders Association Response to the IOSCO Consultation Report:

Regulatory Issues Raised by the Impact of Technological Changes on Market Integrity and Efficiency

Technology has brought numerous changes to the financial markets. The IOSCO Consultation Report on *Regulatory Issues Raised by the Impact of Technological Changes on Market Integrity and Efficiency* ("IOSCO Report") appropriately examines these changes. Numerous studies have provided evidence of the benefits markets and market participants now enjoy because of technology.[1] The IOSCO Report asserts that there are "risks that these innovations pose to the efficiency and integrity of markets" and that "[t]hese changes raise issues that should be addressed by regulators in order to maintain the integrity of financial markets."

The comments presented here represent the views of the FIA Principal Traders Group[2] and the FIA European Principal Traders Association[3] (collectively "FIA PTG/EPTA"). FIA PTG/EPTA members engage in manual, automated and hybrid methods of trading on exchanges located around the world and are active in cash and derivatives in a variety of asset classes, such as equities, foreign exchange, commodities, and fixed income. In their capacity as principal traders, these firms trade for their own accounts and do not handle customer funds. All principal traders have a vested interest in well-functioning markets with effective risk controls, clear error trade policies that focus on trade certainty, and a strong regulatory framework.

The IOSCO Report addresses algorithmic and high-frequency trading in depth. Algorithmic and high-frequency trading have received media attention that has encouraged negative perceptions of these

[1] The FIA PTG/FIA EPTA web sites contain an extensive list of academic papers on high-frequency and algorithmic trading and other market structures issues: http://www.futuresindustry.org/ptg/academic-research.asp.
[2] FIA Principal Traders Group was founded in January 2010 and is comprised of 34 principal trading firms. The purpose of the organization is to provide a forum for firms trading their own capital to identify and discuss issues confronting the PTG community; define common positions on public policy issues and advance the group's collective interests through the FIA; improve public understanding of the constructive role played by the wide variety of individual trading groups in the exchange-traded derivatives markets; and promote cost-effective, transparent access to U.S. and non-U.S. markets.
[3] The FIA European Principal Traders Association was founded in June 2011 and is comprised of 19 principal trading firms. The mission of the FIA EPTA is to support transparent, robust and safe markets with a level playing field for all market participants. The group will work to define common positions on public policy issues, improve the public's understanding of the constructive role played by principal trading groups in the exchange-traded markets and promote cost-effective, equal and transparent access to European markets.

very legitimate trading activities. For regulators, a significant part of the challenge of assessing these new tools is separating fact from perception and understanding the roles algorithmic and high-frequency trading play in the marketplace. Algorithms are tools used to search for trading opportunities or execute orders. High-frequency trading is a method of trading that involves frequent turnover of positions, not a strategy itself. Both algorithms and high-frequency techniques are used by a variety of market participants including principal traders, asset managers and institutional investors.

(A) ALGORITHMIC TRADING

The section of the IOSCO Report on algorithmic trading references the Flash Crash and raises concerns about the interconnectedness of markets, investor confidence, and the cost of trading. In this section, several academic studies are cited that analyze data and provide evidence of the benefits of high-frequency trading on market quality. By contrast, the IOSCO Report provides only anecdotal commentary that some market participants "feel at an inherent disadvantage to these traders' superior technology." It would be unprecedented for IOSCO to make recommendations based solely on anecdotal evidence, especially when the majority of academic studies support a different conclusion[4].

Flash Crash

The IOSCO Report gives a brief summary of the Flash Crash of May 6, 2010. In addition to the points raised, we wish to highlight important lessons learned from the event and refute the belief that high-frequency trading exacerbated the Flash Crash.

Evidence from the joint staff report by the Commodity Futures Trading Commission and the Securities and Exchange Commission showed that the Flash Crash had a disparate impact on the futures market and the equity market as a result of differing market structures. The staffs of the two agencies concluded that a large fundamental trader's order to quickly sell 75,000 CME S&P 500 mini contracts (with a notional value of over $4 billion) created a "liquidity crisis" in the CME E-Mini futures that caused the price to drop more than 5% in four-and-one-half minutes during the most intense part of the episode. The CME stop-logic functionality was triggered, the market paused for five seconds, and buy-side interest returned to the market. The price shock in the futures market was quickly transmitted to the equity markets by inter-market arbitrage transactions and resulted in a period of extremely disorderly trading lasting approximately 15 minutes.

In the equities market, the study found that the liquidity crisis was worse because no circuit breakers were triggered on May 6 and traders lacked confidence that trades would not be "busted." Trades were in fact busted in the equities markets. According to the SEC-CFTC Report, following the crash, "FINRA

[4] See Appendix 1.

and exchanges busted trades that were 60% away from the reference price, using a non transparent process.[5]"

Two market structure characteristics were critical to give principal traders, and other market participants, the confidence they needed to stay in the E-Mini S&P 500 contract on May 6: confidence that the CME would not "bust" trades and the activation of stop-logic or market pause functionality.

As documented in trader interviews in the SEC-CFTC Joint Report on the events of May 6, trade certainty is critically important to all types of traders. They take positions based on trades they believe to be executed and cannot afford to risk losses associated with busted trades. Traders who wished to establish risk neutral positions by offsetting one leg of the position with a position in another product or market feared that one leg of the position could be left to stand, while the offsetting leg of the position could be broken, creating an unacceptable risk.

The second market characteristic--stop-logic functionality—just a few seconds in duration in the case of the CME mechanism—gave market participants enough time to process information and allowed liquidity to return to the markets. The SEC-CFTC report concluded that:

> "As demonstrated by the CME's Stop Logic Functionality that triggered a halt in e-Mini trading, pausing a market can be an effective way of providing time for market participants to reassess their strategies, for algorithms to reset their parameters, and for an orderly market to be re-established."

High-frequency trading did not cause the Flash Crash and in fact absorbed the initial sell orders according to a report released by the CME. In contrast to the IOSCO Report's reference to high-frequency traders exacerbating volatility, the CME review of the trading activity during this period found that most high-frequency traders did not leave the futures markets during the market break and continued to provide liquidity under extreme market conditions. "Based on our review, there is no evidence to support the proposition that high-frequency trading exacerbated the volatility in the markets on May 6.[6]"

The Flash Crash provides an excellent example of how market structure can be designed to help prevent market instability and improve market quality. The futures market had multiple mechanisms in place to deal with high volatility, price banding to prevent orders from being entered beyond a specific range, and an error policy that focused on trade certainty. In fact, not a single E-mini futures contract was busted as a result of the Flash Crash. The securities markets did not have these mechanisms in place across a fragmented marketplace, resulting in more dramatic price moves over a longer period of time.

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[5]See Findings Regarding the Market Events of May 6, 2010: Report of the Staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues, September 30, 2010.

[6] Comments by Bryan Durkin, Managing Director and Chief Operating Officer, CME Group, to CFTC Technology Advisory Committee, July 14, 2010: http://www.cmegroup.com/trading/equity-index/files/CFTC_techadvisory_durkin.pdf.

Accordingly, regulators in the US have appropriately focused their efforts on working with the securities exchanges and FINRA to implement clear error trade policies and coordinated volatility controls. The FIA PTG/EPTA supports these initiatives to improve identified deficiencies in market structure. Such initiatives that reduce market uncertainty are more constructive, and ultimately more effective, than focusing on the tools market participants use to trade the markets.

Market Linkage

The Flash Crash highlighted the coordinated nature of the markets and the IOSCO Report expresses concern about the interconnectedness of markets and the role of automated trading in contagion. FIA PTG/EPTA would respectfully submit that in a fragmented market structure, automated trading contributes to the price discovery process and helps bring market prices in related markets into proper alignment. In addition, recent academic evidence shows that market quality metrics have improved over the past two decades at the same time U.S. equity markets have become more diverse and competitive. For example, Chordia, Roll, and Subrahmanyam (2010) find that effective spreads have declined. They find that lower trading costs and new trading technology have made it easier for the market to accommodate large trading volume. They also find that information-based trading has increased, leading to more efficient pricing, another measure of market quality. Significantly, they find:

"Further, intraday volatility has decreased and hourly/daily variance ratios indicate that prices conform more closely to random walks in recent years, which indicates that increased trading activity has been accompanied by enhanced market quality."[7]

Other studies have also found that market quality metrics have improved in recent years and attribute this result to changes in market structure and the presence of professional traders who compete in these markets.[8]

Investor Confidence

The IOSCO Report specifically mentions that investors may fear the use of low-latency algorithmic trading techniques. These comments, however, are anecdotal in nature and we are unaware of any studies that indicate that investor confidence and the impact on their willingness to trade can be attributed to automated trading. Many factors in today's economic environment are contributing to investor uncertainty. The lack of confidence in the markets could be as much a reflection of the ongoing fallout from the financial crisis, high unemployment rates, and daily news about financial challenges facing many countries. It is unclear the origin of this fear of high-frequency trading; moreover, possible investor fear alone should not be a basis for policy decisions. Regulators must arm themselves with empirical data to help them distinguish perception from reality and can play an important constructive role in educating the public and policy makers about the reality of trading in their markets.

The IOSCO Report is particularly concerned about traditional institutional investors. In fact, institutional investors have for some time been adopting broker-provided execution tools to effectively execute their

[7] See Tarun Chordia, Richard Roll, and Avanidhar Subrahmanyam, "Recent Trends in Trading Activity and Market Quality," Emory Law and Economics Research Paper No. 10-88 . Available on SSRN.
[8] Hasbrouck, Joel and Saar, Gideon, November 2010. Chordia, Tarun, Roll, Richard, and Avanidhar Subrahmanyam.

trades.[9] This includes many of the same tools used by high frequency traders, including fast computers, sophisticated software, exchange co-location and direct market data feeds.

Additionally, competition and automation have improved market conditions for institutional execution. This view is supported by a paper published by a leading asset management firm, BlackRock, in June 2011, citing the importance of high-frequency traders to European markets. "HFT helps to create efficient markets by facilitating price formation, lowering the cost of trading and improving the linkage between markets. All of this, in turn, aids in achieving optimal investment performance for end investors."[10]

Institutional investors and liquidity providers fill different needs in the market and both are valuable to the health and stability of the markets and the price discovery process. For this reason, it is critically important to ensure that regulations do not favor one type of market participant over another.

Cost of Trading

Does algorithmic and high-frequency trading increase the cost of trading for market participants and the cost of market surveillance for competent regulators? Compared to the traditional cost of accessing markets, we believe that automated trading has reduced the cost and leveled the playing field for a broad range of investors. Narrow spreads allow investors to buy and sell shares, contracts, and other financial instruments at better prices and lower costs. More investors have greater access to markets than when trading floors were located in financial centers and access was limited to those with the ability to purchase a membership and the physical stamina to be a successful trader.

All orders and trades flowing through an electronic system can be checked for validity and accuracy, and are stored in detailed, permanent audit trails, making market abuse easier to detect. Trading data is now centralized in a central order book and available in a machine-readable format, replacing handwritten trading cards. The exchanges themselves have always had surveillance programs in place to monitor trading activity. In the past, exchange officials were stationed in every trading pit. Today, they are stationed in electronic trading centers where they can more closely monitor trading activity than ever before.

We support providing regulators with access to full audit trails. We believe that in many markets it is important to take advantage of the surveillance tools already in use by market operators. In the same way it was not possible for government regulators to stand next to every trader in every pit on every trading floor, it would be duplicative, expensive and unnecessary for regulators to maintain the systems and hire the expertise that replicating exchange systems would require.

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[9] The order was executed using an automated execution algorithm. Execution algorithms give all types of market participants the ability to divide an order into a series of smaller orders to achieve more efficient execution than if the order had been entered as an outright order. These electronic order execution tools are useful as they can help minimize execution risk and reduce the total cost of a trade. These algorithms have replaced many of the rote functions that have been historically accomplished manually.

[10] See Equity Market Trading in Europe: The Case for Refinement Over Revolution: https://www2.blackrock.com/webcore/litService/search/getDocument.seam?contentId=1111142483&Source=SEARCH&Venue=PUB_IND.

(B) MARKET FRAGMENTATION AND DARK LIQUIDITY

Competition and Costs

We agree with the IOSCO Report's conclusion that technology and regulatory changes have encouraged competition and the corresponding benefits of lower trading fees and increased innovation. In addition, competition has led to narrower spreads and deeper markets, which reduce trading costs to investors. The IOSCO Report also recognizes that competition has led to greater fragmentation of markets, which may increase the costs associated with searching for the best price. Any increase in search costs, however, does not in any way minimize the fact that the best price – once found – will be a better price than in the absence of the competition facilitated by technology and regulatory changes.

Moreover, the FIA PTG/EPTA ask IOSCO to acknowledge that technology allows information to be aggregated and disseminated to a wide range of investors at relatively low cost. In this regard, we encourage IOSCO to recommend that regulators encourage and facilitate the consolidation of post-trade information. Timely and accurate market data is an important investor protection tool and would mitigate the impact of fragmentation, while retaining the benefits of competition.

Dark Liquidity

Dark or "undisplayed" liquidity is a longstanding means by which investors interact without displaying the full scale of their trading interest and has been around for a very long time. For example, floor-based exchanges allowed floor brokers to manually represent undisplayed liquidity that could be accessed only by sending an order to the floor. With the elimination of most floor-based trading, exchanges continue to offer order types that allow participants to hide all or a portion of their trading interest. Similarly, ATSs and MTFs offer dark order types alongside their displayed markets. In addition, certain trading venues only allow dark orders and do not display any trading interest publicly. Among these "dark pools" are many broker-dealers that internalize their customers' orders.

All these forms of dark liquidity can have the same impact on the market and should, therefore, be analyzed together. The FIA PTG/EPTA, therefore, believes that IOSCO's focus on the subset of dark liquidity it defines as "dark orders" and "dark pools" in its 2011 *Report on Principles for Dark Liquidity* is misplaced. Only by defining the term "dark order" to include only electronic orders that can be automatically executed can IOSCO state that "[t]he benefits of using dark order types were fewer in the past because manual handling of orders, typically by a specialist or market maker, was necessary to trade." However, all manually handled orders are a form of dark liquidity and their impact on price discovery and market integrity should be considered together with electronic dark liquidity.

The FIA PTG/EPTA believes that any analysis of changes in the use of dark liquidity in the market consider all these sources of dark liquidity, not merely the subset of dark liquidity that is electronically accessed and executed. In this regard, BlackRock concluded in a recent paper that "dark liquidity" is a small fraction of the total volume of electronic trading and that "[s]preads in Europe have consistently tightened, indicating that there is no evidence to support that dark pools hinder price discovery."[11]

[11] See Equity Market Trading in Europe: The Case for Refinement Over Revolution: https://www2.blackrock.com/webcore/litService/search/getDocument.seam?contentId=1111142483&Source=SEARCH&Venue=PUB_IND.

Indications of Interest

The IOSCO Report identifies the use of actionable indications of interest (IOIs) as a regulatory issue. The Report questions whether it is fair that some members of trading venues have information that other participants on those venues do not.

The FIA PTG/EPTA believe that, to the extent that IOIs explicitly or implicitly convey information that there is actionable trading interest in a symbol, such IOIs are essentially bids or offers and thus are indistinguishable from quotations. More specifically, an IOI that includes the side (i.e., whether a buy or sell), size and symbol is really a quotation. Because such IOIs are indistinguishable from quotations, they should be considered quotations and subject to the same regulatory obligations as quotations.[12] Those obligations, of course, would depend on the rules applicable in a particular jurisdiction.

We note, however, that there is no analysis of whether treating actionable IOIs in the same way as quotations would increase the number of displayed quotations. Market participants use non-displayed trading interest – such as IOIs – to minimize information leakage. If actionable IOIs were required to be publicly displayed, these market participants may cease using such IOIs and instead seek counterparties through other dark order types. Accordingly, regulators should not assume that requiring display of actionable IOIs would increase the number of "lit" quotations.

(C) DIRECT ELECTRONIC ACCESS

The FIA PTG/EPTA supports the principles IOSCO provided in its 2010 Report, *Principles for the Oversight of Screen-Based Trading Systems*. These principles are consistent with the FIA's *Market Access Risk Management Recommendations*, published in April 2010.[13] These recommendations were the result of input from exchanges, executing and clearing brokers, and trading firms. The recommendations include sections on the roles of the direct access participant, clearing firms and exchanges and execution risk controls such as order size limits, intraday position limits, cancel-on-disconnect capability, kill button, and price banding/dynamic price limits. It also includes recommendations on post-trade controls, co-location, error trade policies and conformance testing.

In addition, the FIA PTG published *Recommendations for Risk Controls for Trading Firms*[14] in November 2010. This document includes a comprehensive set of risk controls applicable to trading operations and electronic trading systems. The recommended risk controls include, and expand upon, those outlined in the *FIA Market Access Risk Management Recommendations*.

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[12] We emphasize that not all IOIs are comparable to quotations. As the IOSCO Report notes, some types of IOIs do not indicate price or quantity. These types of IOIs–in many ways a form of advertising–have existed for many years and do not raise the same fairness concerns as actionable IOIs.

[13] FIA Market Access Risk Management Recommendations are available at: http://www.futuresindustry.org/downloads/Market_Access-6.pdf

[14] FIA Recommendations for Risk Controls for Trading Firms are available at: http://www.futuresindustry.org/downloads/Trading_Best_Pratices.pdf

Risk management best practices are continually evolving due to the ongoing efforts made by many sectors of the marketplace, in light of changing circumstances and technological improvements. Regulators should be hesitant to "freeze" the state of the art by imposing a particular set of risk management controls on market participants – to do so may prevent certain enhancements, and may stifle innovations that on the whole make markets safer.

(D) CO-LOCATION

One of the main benefits of co-location and proximity hosting15 services is that they create a level playing field for firms that want low-latency access to an exchange. Co-location is a new manifestation of the centuries old aspiration to be as close to where price discovery happens as possible. Certain traders have always sought proximity to the center of trading, whether through purchasing a membership or "seat" at an exchange to receive privileged access to an exchange trading floor or, in today's market, leasing space in an exchange's data center. Generally, exchange memberships were fixed in number and therefore access to those exchanges limited both in the short-run and the long-run. By contrast, co-location facilities can be expanded as demand requires, allowing for fairer competition and open access to modern financial markets. Finally, when co-location and proximity sites are not available, it encourages firms to seek confidential knowledge about matching engine locations and compete for building space closest to those engines so they can build their own private data centers. This exacerbates the differences in the ability of market participants to obtain market access.

Fair access to co-location services is, of course, critical and the FIA PTG/EPTA believes that such services should be made available on a transparent and non-discriminatory basis.

(E) TICK SIZES

The effect of tick sizes on market quality is an old issue that pre-dates the development of today's electronic marketplace. Scholars who have looked at the issue emphasize that there is an optimal tick size based on balancing the costs and benefits to the point where overall market quality is maximized (see Sharon Brown, Paul Laux, and Barry Schachter, "On the Existence of an Optimal Tick Size," Review of Futures Markets, 1991, 10(1), pp. 50-72; and Lawrence Harris, "Minimum Price Variation, Discrete Bid-Ask Spreads, and Quotation Sizes," Review of Financial Studies, 1994, 7(1) pp. 149-178). The question is who is in the best position to choose the optimal tick size. Traditionally, this choice has been left to exchanges because of their incentive to choose the tick size that maximizes their own market's quality. Although technology across markets has changed, the factors involved in setting the optimal tick size have not changed. In our view, choices about the optimal tick size are best left to the exchanges who are in the best position to make this choice.

[15] Proximity sites are data centers offered by an exchange or a third-party vendor for low-latency access to an exchange's network via a third-party network connection.

(F) FEE STRUCTURES

The IOSCO Report suggests that exchange fee structures may have changed market behaviors and distorted the price formation process. Typically, exchange incentive programs are designed to attract trading and provide deep, liquid markets, which benefits all market participants. FIA PTG/EPTA support empowering each exchange to provide incentives to attract market makers and electronic liquidity providers that they deem appropriate, as long as such incentives are transparent, and based upon objective criteria. In the past, exchanges have devised innovative methods to incentivize market makers and they must maintain the freedom to do so. Exchanges should be allowed to work with their customers to design fee structures (which it is expected may evolve from time to time) that take into account the market dynamics of individual products.

CHAPTER 3: HIGH-FREQUENCY TRADING

Background and Characteristics

High-frequency trading ("HFT") is an instrument used by a variety of market participants, including electronic liquidity providers ("ELPs"), not a strategy itself. The IOSCO Report partially describes the characteristics of HFT; however, it is critical to more fully discuss the role of ELPs in today's markets and how they contribute to liquidity.

ELPs add liquidity to the marketplace by posting orders in a market. These orders are available to investors and bridge the time gap between natural buyers and sellers who may not be in the marketplace at the same time. ELPs also provide liquidity by trading with natural buyers and sellers who indicate their interest in entering or exiting a position by posting their trading interest on a market. By playing these important intermediary roles, ELPs permit individual and institutional investors to immediately transfer the risk often associated with financial instruments.

Technology is one of the tools ELPs use to efficiently provide liquidity and reduce trading costs for investors. Liquidity providers, traditional or electronic, put their own capital at risk and technology allows these intermediaries to incorporate new pricing information into their orders and continuously manage their open positions.

In addition, the greater control ELPs have over the orders they offer on the market, the less risk exposure for the firm's capital and the better prices and greater size the ELP can offer. The ability to quickly modify orders to reflect updated information in revised prices is integral to this process. For every quote in the market that an ELP provides, it is exposed to that quote for the time it takes to modify the quote. Similarly, for every position an ELP holds, it is exposed to the risk associated with that position until a proper hedge can be executed. The higher the speed of their quoting and position management systems, the less time elapses between when information is received and when that information is incorporated into subsequent orders. For any given order or position, the value of this fraction of a second of exposure is very low, but across an entire market the exposure can be

significant. In those markets where exchange speeds are high (and latencies low), ELPs are able to manage their risk more effectively and are therefore willing to quote narrower spreads for larger size and fill resting orders more frequently, all of which improves liquidity and reduces costs for end users.

The relationship between speed, spreads, and liquidity is evident on many exchanges and clearly adds value to all participants. Over the past 10 years, major markets have become substantially more liquid with narrower spreads. Academic studies have shown the clear improvement to market quality that follows advances in technology and greater speed.[16]

Strategies Employed

The IOSCO Report identifies three widely used strategies that involve HFT. FIA PTG/EPTA agrees that HFT can be used for almost any type of strategy that involves frequently turning over positions. Below is our analysis of the strategies included in the report. These strategies can be applied in any financial product including equities, futures, options, FX and ETFs. It should be noted, however, that strategies rarely fit into neat classifications. For example, market making and arbitrage strategies are closely linked. Particular trading systems or strategies may often deploy multiple components of the general categories of strategies outlined below.

Market Making. A strategy that involves continuously posting passive limit orders on both sides of the order book. The report correctly describes the distinction between an official market maker and an unofficial market maker, but it is important to note that in both cases the market maker performs the same, invaluable service to the market—providing liquidity to the marketplace by posting resting limit orders. By playing this important intermediary role, electronic liquidity providers permit individuals and institutional investors to immediately enter into desired positions and hedge the risk associated with their open positions.

Arbitrage and Statistical Arbitrage. A strategy that searches for discrepancies in well-defined or fuzzy pricing relationships. The report correctly describes the two main types of arbitrage strategies--pure arbitrage and statistical arbitrage. These types of strategies help to transfer liquidity between related markets, and aid in price discovery and help make markets more efficient by removing price discrepancies. Although arbitrage strategies are commonly associated with HFT, they predate all forms of electronic trading including algorithmic and HFT. Arbitrage opportunities exist because market participants often have differing views on the value of tradable products. As markets have become more efficient, true arbitrage opportunities have become increasingly rare and short-lived. Because of this, market participants often use low-latency trading techniques in order to capture these opportunities.

[16] See Terrance Hendershott, Charles M. Jones, and Albert J. Menkveld, "Does Algorithmic Trading Improve Liquidity," *Journal of Finance*, Vol. 66, No. 1, February, 2011; Joel Hasbrouck, "Low-Latency Trading," Working Paper, Stern School of Business, New York University, November, 2010; Jonathan Brogaard, "High-Frequency Trading and its Impact on Market Quality," Working Paper, Kellogg School of Management and the Northwestern University School of Law, Northwestern University, July, 2010.

Directional Strategies. The IOSCO report correctly describes directional strategies; however, it is important to note that the vast majority of liquidity providers do not use strategies in this category due to their aversion to directional risk.

Risks Posed to Market Integrity and Efficiency

The IOSCO Report expresses concern that "apparently non abusive practices" result in harm to market quality. However, the IOSCO Report acknowledges that during panel discussions no evidence of abusive practices by HFT was presented. Regulation should be based on evidence and not on perception or assertions that lack a factual basis.

Risks to Fairness and Integrity of Markets

The IOSCO Report states that some market participants expressed concerns that partial ownership of new trading venues by HFT firms would raise conflicts of interests in the governance of these trading venues. Prohibiting or establishing aggregate caps on ownership of new trading venues (ATSs/MTFs) by high-frequency trading firms would reduce the likelihood that new trading venues with a broad group of liquidity providers would be established. Attempts to limit participation in the governance of the entity would limit an investor's interest. Any restriction would deter qualified investors from committing capital to start-up new execution venues. An initial strategic investor in an emerging marketplace, that is already highly competitive, would demand some control over the initial direction of the exchange in order to preserve its investment.

FIA PTG/EPTA RESPONSE TO SELECTED QUESTIONS

(Q1) What impact have the technological developments in the markets in recent years had on your own trading? Has it encouraged, discouraged or had no impact on your willingness to participate on the lit markets, and how does this differ between asset classes and/or instruments?

Advances in telecommunications, falling hardware costs, widely available co-location facilities, and efficient market APIs have made it possible for a broader range of market participants to have better access to markets than ever before. FIA PTG/EPTA believe that this has improved market quality in a number of measurable ways: bringing liquidity to the markets, tighter bid/ask spreads, reduced volatility, increased price transparency, and provision of continuous markets.

***(Q2) What are your views on the suggestion that proprietary trading firms (including HFT firms) that are not currently subject to registration/authorisation by a regulator should be required to obtain such a registration/authorisation? Are there specific regulatory requirements you believe such firms should face? To what extent do your answers differ if the proprietary trading firm accesses the market as the customer of an intermediary firm through DEA (i.e. under that* intermediary's trading rules/codes) rather than as a direct member of the market itself?**

The FIA PTG/EPTA supports well-regulated markets. Regulators need complete audit trails, including accurate trade reports. In addition, orders of all participants should be subject to risk management controls either directly when the participant is a regulated entity or through an intermediary responsible for its client's access to the market.

There are a range of ways to achieve these goals and FIA PTG/EPTA expects that regulators in different jurisdictions will take different approaches depending on the legal and regulatory tradition in that jurisdiction. For example, the regulatory framework in Europe is fragmented, with each country having its own national regulator. In addition, exchanges have not taken on the role of self-regulatory organizations. Accordingly, we think it is important that in Europe firms with direct access to markets be authorized by a competent national authority. On the other hand, regulation in the US is less fragmented and there is a stronger role played by self-regulatory organizations, such as FINRA and the exchanges. This regulatory framework would allow regulatory objectives to be effectively implemented through exchange and SRO rules.

Accordingly, the FIA PTG/EPTA recommends that IOSCO develop principles that identify regulatory goals. The particular way in which such goals are implemented should be left for regulators to determine, based on the legal and regulatory structure in that jurisdiction.

(Q3) What recommendations, if any, would you propose to strengthen the regulatory requirements around pre- and post-trade risk controls? In particular, what measures, if any, do you think regulators should introduce that relate specifically to the use of and risks posed by algorithmic trading and/or HFT?

FIA PTG/EPTA believe that market integrity is the shared responsibility of exchanges, clearing firms, and trading firms. Each have a role in ensuring that appropriate risk controls are in place. As indicated in our comments in (C) Direct Electronic Access, FIA worked with clearing firms, trading firms and exchanges to publish risk management recommendations with guiding principles that describe the type of control that should be put in place and specific implementation recommendations. The document further supports harmonization of risk controls across exchanges. In addition, FIA PTG published Recommendations for Risk Controls for Trading Firms for risk controls applicable to trading operations and electronic trading systems.

Risk management best practices are continually evolving due to the ongoing efforts made by many sectors of the marketplace, in light of changing circumstances and technological improvements. Regulators should be hesitant to "freeze" the state of the art by imposing a particular set of risk management controls on market participants—to do so may prevent certain enhancements, and may stifle innovations that on the whole make markets safer.

(Q4) To what extent do you believe the use of trading control mechanisms such as circuit breakers and limit-up/limit-down systems by trading venues should be mandated? If you believe they should be mandated, should venue operators be permitted to design their own controls or should they be harmonised/coordinated across venues (including between interrelated instruments such as a derivative and its underlying)?

The FIA PTG/EPTA supports appropriate market pauses, circuit breakers and price limits as mechanisms to give market participants the opportunity to adjust to extreme market conditions17. FIA PTG/EPTA, however, believes that these mechanisms should be established with the goal of keeping markets open as much as possible because, among other things, market closings may dramatically reduce market participants' ability to manage risk. These mechanisms should not be used exclusively, but rather along with appropriate risk controls, such as price banding and maximum order size limits in order to avoid outright trading halts.

Trading halts are intended to protect against the possibility of a broader market breakdown and should not be used to compensate for weaknesses in trading processes or a temporary reduction in liquidity. As such, FIA PTG/EPTA recommends that automated risk and volatility mitigation mechanisms be implemented in place of trading halts. A single errant trade can have the effect of causing a halt in the trading of a security. Clearly, isolated events caused by human error or system malfunction are not the types of events that justify the activation of a trading halt. In addition, allowing isolated events to disrupt all trading in a security introduces the possibility of a single market actor intentionally halting markets for manipulative purposes.

[17] For the purposes of this paper, we use "circuit breaker" to describe the mechanism that triggers a pause in execution and "market pause" to describe such a pause. "Trading halt" is any circumstance where there is an unscheduled stoppage of matching. In the futures trading environment, "Limit up-limit down" implies that there is a static price limit for a trading session.

Proven market mechanisms are available that mitigate volatility caused by transitory liquidity gaps and that minimize the risk of clearly erroneous trades—without the need for disruptive market halts and without the disruption associated with error trades and their cancellation. Such mechanisms allow markets to be paused for a short amount of time to allow the market to process information and recover from a transitory dearth in liquidity.

FIA PTG/EPTA recommends that all trading venues adopt automated means, to briefly pause their market in the event that a circuit breaker is triggered. The momentary pause afforded by this type of functionality allows an opportunity for liquidity to be replenished. In a highly transparent and efficient market, the pause can reasonably be calibrated to seconds without substantive impacts on the broader market. The benefit of this type of functionality was clearly evident on May 6, 2010, as stop-logic functionality on CME Globex triggered a five-second pause in the E-mini S&P futures market, during which time buy orders came into the market, leading to the reversal of the broader market decline.

The Eurex volatility interruption is a specific protective mechanism to enhance price continuity and the probability of matching market orders in futures products. Eurex sets product-specific price corridors at the individual contract level based on the contract's pricing characteristics. If two prices are outside the price corridor in a predefined timeframe, the volatility interruption mechanism is triggered. The price corridors are calculated regularly and are chosen so that continuous trading is rarely interrupted even in volatile phases.

Another process that should be considered to limit volatility is “price banding.” Price banding is in effect on CME, NYSE Liffe and NYSE Liffe US systems to limit the likelihood of erroneous executions well out of range of the current market. It is essential that such a limit remain dynamic and well outside the range of the current market, as short-term volatilities cause such limits to be an artificial barrier to trading and may cause price jumps when bands are too close and then reset.

Regardless of their methodology, trading halts should take into consideration the unique characteristics of the product, should be set by the exchange at the product level and should be coordinated across trading venues as appropriate. They should perhaps be set at tighter ranges but be shorter in duration. Given today’s highly efficient market structure and sophisticated information processing technology, shorter halts are sufficient to allow market participants to assimilate information, assess risk and resume trading in an orderly manner.

Special consideration should be given to trading halts during the closing period due to the risks associated with suddenly losing the ability to hedge or close open positions before the market closes for the day, or even worse, the weekend. For instance, if a significant event were to occur during the closing period on a Friday, the market could be halted due to volatility protections. If the market is halted through the exchange close, the next opportunity traders would have to hedge or close-out their open risk would be Sunday evening, 48 hours after the event.

(Q5) To what extent do you believe market maker schemes offered by trading venues should be subject to mandatory minimum criteria? Should the criteria be determined by the trading venue

alone? To what extent do you agree with the suggestion that the use of stub quotes should be prohibited?

The FIA PTG/EPTA supports exchange-based initiatives—particularly those that are market-based—that encourage liquidity provision and promote the stability of those markets in which FIA PTG/EPTA members place their capital at risk. As a result, we fully support empowering each exchange to provide incentives to attract market makers and electronic liquidity providers that they deem appropriate, as long as such incentives are transparent, based upon objective criteria, and do not disadvantage other market participants18. In the past, exchanges have devised creative methods to incentivize market makers, and they must maintain the freedom to do so.

We do not, however, believe that regulators should be creating incentives for market making or erecting unnecessary barriers to competition. We share concerns, such as those stated by the recent Joint CFTC/SEC Advisory Committee, about depending on market-maker obligations as a "guarantee" of market liquidity, even during periods of market stress. Not only would such benefits likely be illusory, a privileged regulatory status provided to selected market makers would create unfair advantages over other market participants, dampening competition and, therefore, likely reducing liquidity, including during times of market stress. Furthermore, the cost of the reduction in competition and liquidity would be borne by all other investors in the form of wider spreads, increased volatility and higher trading costs.

That said, we support the ability of markets to innovate and compete to attract market participants using a wide variety of tools, including their own market making programs. We view this as a competitive issue, rather than a regulatory issue.

One example of market-based reform members of the FIA PTG/EPTA support is the recent implementation of minimum quoting requirements by primary and supplemental market makers that effectively eliminate the ability of market makers to employ "stub quotes."

(Q6) Do you have suggestions for improvements to regulators' surveillance capabilities with respect to the markets and modern trading techniques? Please elaborate. Who should bear the cost of investing in such capabilities and the cost of operating and supervising the markets in order to ensure fairness among market participants? Please elaborate.

Automated trading provides a permanent audit trail and we believe that regulators should have access to the full spectrum of this order audit trail information. We believe that this can be done in a cost effective manner by leveraging existing audit trail information and exchange data repositories.

(Q9) Do you think existing laws and rules on market abuse and disorderly trading cover computer generated orders and are relevant in today's market environment?

We support a regulatory environment that promotes fair competition and gives regulators the tools they need to detect and deter abuses. Disruptive, manipulative or fraudulent trading is not appropriate

[18] For example, we would not support limiting the ability to stream quotes to only designated market makers.

regardless of whether the orders are manually or computer generated. Many existing laws are clearly relevant to automated trading particularly in the area of fraud and manipulation.

When considering existing and new laws and rules, FIA PTG/EPTA believes:

- Regulators should identify specific problems that would necessitate additional enforcement authority to prosecute market abuse or disruptive trading practices.
- Overly broad rules on antidisruptive trading practices that lack a manipulative intent requirement could capture legitimate trading practices, which without manipulative intent, are objectively indistinguishable from the proposed prohibited conduct and could chill legitimate trading activity.
- Rules designed to establish conduct and compliance standards, should not be so broad or undefined so as to cause market participants to fear that their trading activity may be subject to post hoc analysis which labels a trade or a series of trades "manipulative" or "disruptive."
- Regulators should maintain their focus on market manipulation, leaving the exchange the authority to monitor and regulate market disruptions.

(Q10) Are there any strategies employed by HFT firms that raise particular concerns? If so, how would you recommend that regulators address them?

Any type of manipulative behavior whether it's manually or computer generated should be prohibited, and existing rules against such activity should be strictly enforced. Manipulative practices, unfortunately, are not uniquely employed by any particular type of market participant; rather, they have been employed by participants for many years, whether by means of high-frequency trading techniques or not. As such, their prohibition warrants continued and rigorous enforcement. Please note that terms commonly used to describe disruptive behavior are difficult to define, which could result in prohibitions against legitimate trading behavior.

As previously discussed, FIA PTG/EPTA support providing regulators with the tools necessary to detect and deter manipulative conduct. Also, as noted earlier, unlike floor trading, automated trading activity already has a full audit trail.

(Q11) Should charges or fees be imposed on messages, cancellations or high order-to-trade ratios? If so, how should the fees or charges be determined and on what basis?

Exchanges should implement policies around message use to discourage market participants from creating excessive, low quality messaging, which can negatively impact both exchange and customer bandwidth and systems. An example of a creative, non-prescriptive, and effective approach to curtailing superfluous bandwidth usage while maintaining a deterministic order life-cycle is IntercontinentalExchange's "Weighted Volume Ratio" ("WVR") messaging rule. ICE's WVR accomplishes all of this by defining a ratio between the number of messages (new orders, cancels, modifies, etc.) an electronic trading system ("ETS") sends and the total volume of orders the ETS executes. If an ETS exceeds the posted WVR limits, the ETS' owner is fined. If this behavior continues, the ETS' owner faces possible suspension of direct market access privileges.

The truly creative part of this solution is that ICE assigns a weighting scale based on the message's price level relative to the current best bid and offer. If the order in question has a price equal to the best bid or offer, the message does not count towards the WVR. If it is one tick away from the best bid or offer, the message has a weighting multiplier of 0.5 for orders on outright futures and 0.25 for spreads. This multiplier continues to increase until the order in question is more than five ticks away from the best bid or offer. At that point, the message has a weighting multiplier of 3.0 for outright futures and 2.0 for spreads. By imposing the WVR, ICE has simultaneously incentivized firms to submit orders that are likely to be filled while penalizing firms that submit orders that are unlikely to be filled.

With regard to enforcing order-to-trade ratios, we strongly believe that this is best left to commercial forces. Many exchanges have order-to-trade ratios in place, based on infrastructure capacity. Many of the MTFs in Europe attempting to compete with the incumbent exchanges tend to have no order-to-trade ratios in place as their technology tends to be more advanced. Enforcing an order-to- trade ratio would therefore be distinctly anti-competitive as it would virtually kill any new initiative to start a new exchange.

In addition, such a rule could also be very damaging to liquidity in derivative products such as ETFs, listed options and also some illiquid equities. These products cannot exist in an exchange environment without the support of liquidity providers and they often will need to update quotes many times before trading. Arbitrary order-to-trade ratios will either mean substantially wider bid ask spreads or may make some liquidity providers drop several products altogether. If there is a concern that orders and quotes have no intention to trade, it may make sense to explore a rule where quotes and orders need to be a maximum percentage away from the best price available in the market at the time.

Finally, we note that mandating particular order-to-execution ratios is not an entirely effective means of control. It is illogical that a firm would be prevented from engaging in a trading strategy that placed an excessive number of orders for each execution by itself but would be allowed to operate the same strategy if it were coupled with enough other, low order-to-execution strategies. Whether a pattern of behavior should be discouraged should not be based on whether other, unrelated patterns happen to be present as well. (It would also be impractical to attempt to distinguish between multiple trading strategies.) Because of such unintended consequences, we believe that markets looking to enact policies to encourage efficient messaging would be better served by something other than order-to-execution ratios.

(Q12) Should market operators be required to make their co-location services available on a fair and non-discriminatory basis?

FIA PTG/EPTA agrees that market participants that are willing to pay for co-location and proximity hosting should have equal access to these services. Exchanges should have a transparent and fair process for allocating space in a co-location facility. For example, whenever a new co-location facility is made available there should be an introductory period where each market participant is offered the

same amount of space so that everyone is allowed an equal chance to get space when the data center is launched. Once a data center is full, space should be made available on a first come first serve basis.

Although many exchanges provide fair and equal access to co-location facilities, there is a growing trend for exchanges to in-source the operation of data centers, thereby creating potentially undesirable forms of vertical silos. Exchanges should not be allowed to block qualified third-parties from providing co-location or proximity hosting services to market participants. Exchange requirements for third-party providers should be non-discriminatory and readily available for market participants, third-party providers and regulators to review.

(Q13) Should market operators be required to provide testing environments to enable participants in stress test their algorithms? If so, what kind of minimum requirements are reasonable?

In its Market Access Risk Management Recommendations, the FIA recommended that exchanges should provide a conformance testing environment and direct access market participants be required to pass an initial set of conformance tests. These "best practices" were designed by trading firms, clearing members and exchanges and would be too prescriptive if enacted at the government level. FIA PTG/EPTA believe that exchanges should be required to provide testing environments; however, the specific features of the testing environment should be left to the exchanges to determine based on the characteristics of their execution platform and the products they trade.

(Q14) To what extent do you have other comments related to the risks to market integrity and efficiency raised by the issues in this report?

We believe that any changes aimed at strengthening market structure must also preserve the substantial gains that have accrued to the investing public from automation and competition.

Appendix 1
High Frequency Trading Literature Review
June 2011

This brief literature review presents a summary of recent empirical studies related to automated or "high-frequency trading" (HFT) and its impact on various markets.

Author(s) / Title	Dataset	Findings
Angel, Harris, Spatt "Equity trading in the 21st century", February 2010	U.S. equities, 1993 – 2009	Trading costs have declined, bid-ask spreads have narrowed and available liquidity has increased
RGM Advisors "Market Efficiency and Microstructure Evolution in US Equity Markets: A High Frequency Perspective", October 2010	U.S. equities, 2006-2010	Bid-ask spreads have narrowed, available liquidity has increased and price efficiency has improved
Credit Suisse "Sizing Up US Equity Microstructure", April 2010	U.S. equities, 2003-2010	Bid-ask spreads have narrowed, available liquidity has increased and short-term volatility (normalized by longer term volatility) has declined
Hasbrouck, Saar "Low-Latency Trading", May 2011	U.S. equities, full NASDAQ order book June 2007 and October 2008	Low latency automated trading was associated with lower quoted and effective spreads, lower volatility and greater liquidity
Hendershott, Riordan "Algorithmic Trading and Information", August 2009	Automated vs. other trades. Deutsche Börse equities, January 2008	Automated trades made prices more efficient and did not contribute to higher volatility
Chaboud, Hjalmarsson, Vega and Chiquoine "Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market", October 2009	Automated vs. other trades. EBS forex market, 2006-2007	Automated trades increased liquidity and may have lowered volatility

Author(s) / Title	Dataset	Findings
Brogaard "High frequency trading and its impact on market quality", August 2009	HFT vs. other trades. U.S. equities on Nasdaq, various periods in 2008 – 2010	HFT helped to narrow bid-ask spreads, improved price discovery and may have reduced volatility
Hendershott, Riordan "High Frequency Trading and Price Discovery" (working paper)	HFT vs. other trades. U.S. equities on Nasdaq, various periods in 2008 – 2010	HFT trades were positively correlated with permanent price changes and negatively correlated with transitory price changes, suggesting that HFT improves price discovery
Jarnecic, Snape "An analysis of trades by high frequency participants on the London Stock Exchange", June 2010	HFT vs. other trades. LSE equities, April – June, 2009	HFT improved liquidity and was unlikely to have increased volatility
CME Group "Algorithmic trading and market dynamics", July 2010	Automated vs. other trades. CME futures, May 2008 – May 2010	Automated trading was associated with improved liquidity and reduced volatility
Menkveld "High Frequency Trading and the New-Market Makers", April 2011	Dutch equities traded on Chi-X and Euronext, 2007	A single high frequency trader played an important role in the development of a competitive market center, resulting in better liquidity and lower trading costs
Hendershott, Jones, Menkveld "Does Algorithmic Trading Improve Liquidity?", February 2011	Automated quoting facility, NYSE equities, 2003	Automated trading narrowed bid-ask spreads, lowered trading costs, and improved price efficiency
Riordan, Storkenmairm "Latency, Liquidity and Price Discovery", 2009	Xetra high-speed trading system, Deutsche Börse, 2007	Higher system speeds led to increased liquidity and improved price discovery
Hendershott, Moulton "Automation, Speed and Stock Market Quality: The NYSE's	NYSE TAQ database plus others, June 1, 2006 - May 31, 2007	Introduction of automation via the NYSE hybrid system improved price discovery and

Author(s) / Title	Dataset	Findings
Hybrid", February 2010		made prices more efficient
Gomber, Arndt, Lutat, Uhle "High Frequency Trading", 2010	Various	Survey paper that highlights beneficial aspects of HFT, while noting that perceived problems are largely a result of U.S. market structure

This following studies measured improvements in overall market quality:

Angel, Harris and Spatt (February 2010) examined many measures of market quality and how they have changed over time and in response to regulatory and structural changes in the U.S. equity markets.[19] Drawing from a diverse set of data sources, they show that there has been significant improvement in virtually all aspects of market quality. They state "execution speeds have fallen, which greatly facilitates monitoring execution quality by retail investors. Retail commissions have fallen substantially and continue to fall. Bid-ask spreads have fallen substantially and remain low, although they spiked upward during the financial crisis as volatility increased. Market depth has marched steadily upward. Studies of institutional transactions costs continue to find U.S. costs among the lowest in the world."

RGM Advisors, LLC (October 2010) studied recent data from the U.S. equity markets.[20] The authors examined trends in a number of U.S. equity market quality metrics over the period from January 2006 through June 2010 and how these metrics differed by market capitalization and by listing venue. They presented data that confirmed that over this period quoted bid-ask spreads declined, quoted market depth increased and short-term measures of market efficiency significantly improved.

Credit Suisse (April 2010) released a report on related topics and showed that in recent years, bid-ask spreads declined, depth at the inside quote increased and intra-day volatility normalized by longer-term volatility declined substantially.[21] The authors concluded on this last point that "[t]his seems to be confirmation that the new market participants are successfully finding and removing mispricings, as well as dampening volatility that might otherwise be created by large institutional orders filled during the day."

Hasbrouck and Saar (October 2010) explored the nature and impact of low-latency (algorithmic) trading on the NASDAQ exchange during June 2007, a 'nominal' market period, and October 2008, a

[19] Angel, J., Harris, L. and Spatt, C., "Equity trading in the 21st century", http://papers.ssrn.com/so13/papers.cfm?abstract_id=1584026

[20] Castura, J., Litzenberger, R., Gorelick, R., and Dwivedi, Y., 2010: "Market Efficiency and Microstructure Evolution in US Equity Markets: A High Frequency Perspective", http://www.rgmadvisors.com/docs/MarketEfficiencyStudyOct2010.pdf

[21] Credit Suisse, 2010: "Sizing Up US Equity Microstructure", https://tradeview.csfb.com/edge/Public/Bulletin/Servefile.aspx?FileID=14377&m=1337434953

volatile, uncertain period.[22] They identified periods of high market activity due to algorithms and relate these to longer-term market quality metrics such as spread, effective spread and depth of liquidity. They observe in both periods "that higher low-latency activity implies lower posted and effective spreads, greater depth, and lower short-term volatility."

The following studies examined market data sets that distinguished between automated trades and other trades:

Hendershott and Riordan (August 2009) reported on the impact of automated trading on the Deutsche Börse's Xetra market, an equity market where automated trading activity could be distinguished.[23] The paper found that automated trading accounted for about half of the total volume in the top 30 volume stocks, and that automated trading was better than non-automated trading at driving prices toward efficiency. The authors also showed that automated trading "contributes more to the discovery of the efficient price than human trading." Furthermore, they find there is "no evidence of [automated trading] behavior that would contribute to volatility beyond making prices more efficient."

Similarly, in the foreign exchange market, **Chaboud, Hjalmarsson, Vega and Chiquoine (October 2009)** used a dataset that separately identified computer generated trades from human generated trades and showed that an increase in automated trading may be associated with less market volatility, and that automated traders tend to increase liquidity provision after exogenous market events such as macroeconomic data announcements.[24]

Brogaard (August 2010) investigated the impact of "high frequency trading" or "HFT" on US equity trading on the NASDAQ exchange.[25] Using a data set provided by the exchange that labeled all activity as either 'HFT' or 'everything else', Brogaard examined the exact impact that HFT participants have on the market. His analysis used a well-known regression framework to isolate various factors in the market and how HFT impacts each of these. In particular, he shows that HFT activity contributes more to price discovery than other activity, that HFT quotes are at the best bid or best ask price about 50% of the time, that HFT reduces price impact (an important component of trading costs) for other participants, and that HFT activity reduces volatility.

Hendershott and Riordan (2011) examined the impact of HFT on the price discovery process using the same dataset used in Brogaard (2010).[26] Overall they found that HFT trades are positively correlated with permanent price changes, thereby aiding price discovery, and are negatively correlated with

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[22] Hasbrouck, J. and Saar, G, "Low-Latency Trading", http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1695460

[23] Hendershott, T. and Riordan, R., 2009: "Algorithmic Trading and Information", http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1472050## ("Hendershott and Riordan (2009)")

[24] Chaboud, Alain, Hjalmarsson, Erik, Vega, Clara and Chiquoine, Ben, "Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market" (October 2009). Federal Reserve Board International Finance Discussion Paper No. 980, http://ssrn.com/abstract=1501135 ("Chaboud, Hjalmarsson, Vega and Chiquoine (2009)").

[25] Brogaard, J., "High frequency trading and its impact on market quality", http://papers.ssrn.com/so13/papers.cfm?abstract_id=1641387

[26] Hendershott, T. and Riordan, R., 2011: "High Frequency Trading and Price Discovery", working paper

temporary pricing errors, thereby improving the price discovery process. By distinguishing trades initiated by an HFT, the authors found that marketable high frequency trades actively drive prices towards fair value.

A similar study done by **Jarnecic and Snape (June 2010)** used data provided by the London Stock Exchange (LSE).[27] Like the NASDAQ data set, this set labeled all activity by participant type; HFT, investment bank, retail, etc., providing a finer granularity of participation rates and behaviors. The authors used a similar regression framework as Brogaard in order to isolate the impact of HFT on various market metrics. They found that HFT participants tend to provide liquidity when spreads are wide, demand liquidity when spreads are narrow, that they are more likely to "smooth out liquidity over time and are unlikely to exacerbate stock price volatility".

The CME Group (July 2010) released a report on automated trading activity on the CME futures exchange.[28] They labeled all participants as either "ATS" (automated trading system) or "non-ATS." They compared trade volume and messaging rates for each participant against market measures such as liquidity and volatility. ATS's impact on these measures varies by futures contract, but as a whole, they concluded that ATS-based "volume and message traffic tend to be associated with enhanced liquidity and reduced volatility".

Menkveld (2011) studied the development of the Chi-X European stock MTF in 2007 and the simultaneous entry of a large high frequency trading participant on Chi-X.[29] He found that this new participant was largely responsible for the increase in market share of Chi-X and ultimately led to reduced spreads for the stocks that it traded.

These event studies investigated the impact of improvements to a market center's trading technology:

Hendershott, Jones and Menkveld (2007) examined the impact on the NYSE of their auto-quoting facility introduced in 2003.[30] This study showed that for all stocks, and particularly large-cap stocks, automated trading increased liquidity. It also demonstrated that the increase in automated trading caused a reduction in effective spreads, thereby reducing costs to investors.

Similarly, Riordan and Storkenmairm (2009) reported on how a 2007 upgrade to the Deutsche Börse's Xetra trading system focused solely on latency reduction, positively affected market quality.[31] After

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[27] Jarnecic, E. and Snape, M., "An analysis of trades by high frequency participants on the London Stock Exchange", http://mfs.rutgers.edu/MFC/MFC17/MS/MC10~447_Snape_Jarnecic.pdf

[28] The CME Group, "Algorithmic trading and market dynamics", http://www.cmegroup.com/education/files/Algo_and_HFT_Trading_0610.pdf

[29] Menkveld, A., 2011: "High Frequency Trading and the New-Market Makers", available from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1722924

[30] Hendershott, T., Jones, C.M. and Menkveld, A.J.,: "Does Algorithmic Trading Improve Liquidity?", Journal of Finance, Volume LXVI, No. 1, February 2011

[31] Riordan, R. and Storkenmairm, A., 2009: "Latency, Liquidity and Price Discovery", http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1247482

latency reductions in the exchange's trading systems, liquidity increased across market capitalization and trade sizes, and adverse selection and permanent price impact were dramatically reduced.

Hendershott and Moulton (2010) studied the introduction of the NYSE hybrid system in 2006, which moved the NYSE to a faster and more automated matching system. [32] They found that prices became more efficient due to faster price discovery and reduced noise in prices.

This paper provides an overview of "high frequency trading" and related market structure issues:

Gomber et al (2011) presented background information on HFT. Their paper analyzed HFT and "certain proposed regulatory measures.[33] They claimed that HFT is a technology rather than a strategy, and is a natural evolution in the market place. They highlighted the beneficial aspects that HFT can provide, and noted that perceived problems with HFT are largely a result of U.S. market structure rather than anything inherent in HFT itself. They provided several recommendations for policy makers that would maintain the beneficial aspects of HFT while providing markets with additional safety.

[32] Hendershott, T. and Moulton, P., 2010: "Automation, Speed and Stock Market Quality: The NYSE's Hybrid", available from http://www.hotelschool.cornell.edu/research/facultybios/research-papers/p-moulton-research.html

[33] Gomber, P., Arndt, B., Lutat, M., and Uhle, T., 2011: "High frequency Trading", available http://www.frankfurt-main-finance.com/en/data-facts/study/High-Frequency-Trading.pdf