

High-frequency trading – a discussion of relevant issues

Press Workshop

London, 8 May 2013



Agenda

HFT – background

- How do you define high-frequency trading (HFT)?
- What are the most common HFT strategies?
- Why is the speed so important?
- What is the impact of HFT on market quality?

HFT – issues

- Do HFT users cause volatility?
- Why are there critical voices on HFT from institutional investors?
- How do HFT firms (re-)act in critical times?

HFT – Regulation

- How do regulators deal with HFTs?
- What impact does the German HFT Bill have for HFTs?

Differentiation of “algorithmic trading” (AT) and HFT

Common factors of AT and HFT:

- Pre-designed trading decisions
- Used by professional traders
- Observing market data in real-time
- Automated order submission, automated order management
- No human intervention
- Use of direct market access

Typical characteristics of AT excl. HFT

- Primary agent trading
- Minimize market impact (for large orders)
- Significant positions overnight
- Typical holding periods: days/weeks/months
- Working an order through time and across markets

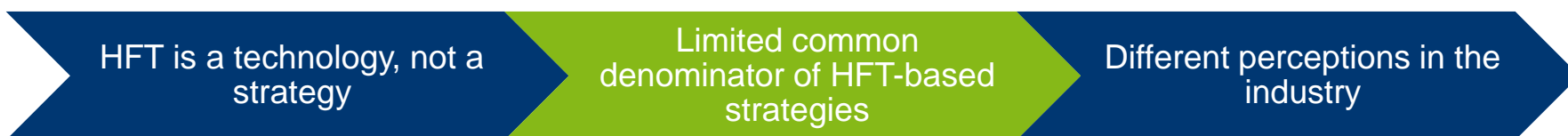
Typical characteristics of HFT

- Proprietary trading
- High number of orders, rapid order cancellation
- Mainly spread and arbitrage income
- No significant position at the end of a day (flat position)
- Short holding periods, small margin per trade
- Low latency requirement
- Focus on highly liquid instruments

Source: Gomber et al. (2011)

HFT is a technology applied to a broad spectrum of strategies

A conclusive definition of HFT is difficult since it is the technology necessary for implementing a broad range of latency sensitive strategies.



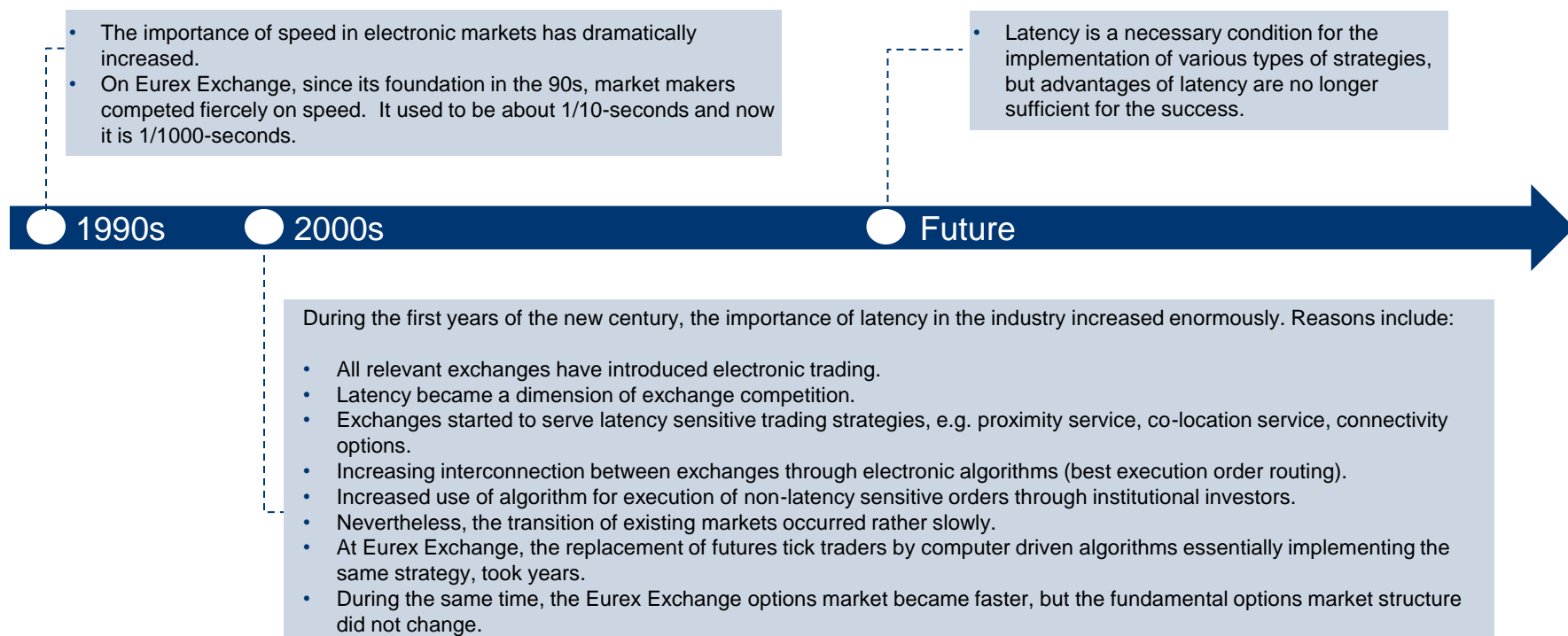
- HFT uses a wide range of strategies with very different characteristics.
- HFT is an advanced implementation of pre-existing strategies.

- HFT-based strategies only have one thing in common, the need to be competitively fast in order to address profit opportunities and, more importantly, avoid being taken advantage of by others, i.e. avoid losses.

- Everyone in the financial industry has an individual idea of what HFT is.
- The opinions on HFT vary considerably depending on what the observer considers a typical HFT strategy.
- The majority of Eurex Exchange's options Market Makers do not consider themselves HFT, while they would fulfill the existing definition of HFT.

HFT is a natural evolution of financial markets based on technological progress and competition

- The term HFT was coined in approximately 2006.
- However, there was no binary event at which HFT strategies/firms entered the market.
- Speed has always been an essential factor for success in exchange trading, e.g. the pneumatic tube system of NYSE (1903).



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The majority of HFT- based strategies belong to two types: Liquidity provision and arbitrage*

Liquidity provision

- The majority of HFT-based strategies are liquidity provision strategies, as every form of liquidity provision in electronic markets requires extremely fast response times.
- The reason is all provided bids and offers are based on certain sets of information.
- When information changes, this implies different prices, bids and offers.
- Accordingly, liquidity providers need to be as fast as possible in: a) receiving the new information, b) transforming the new information into new prices, bids/offers and c) update the bids/offers provided to the exchange.
- The faster the liquidity provider can act, the lower the risk of liquidity provision and the higher the quality of provided quotes.
- **Primary source of income: Spread.**

(Statistical) arbitrage

- Take advantage of price differences (market inefficiencies) between economically identical or similar products.
- Actors calculate fair product values/spreads, and in case of any deviations, they sell the more expensive product, and buy the cheaper product.
- This way, unjustified price differences between economically related products are eliminated.
- Arbitrage assures clients fair pricing across all markets/products and thereby reduces their information costs in fragmented markets.
- **Primary source of income: Short term market inefficiency.**

* Hagströmer, Nordén (2012) found that 63 - 72 % of HFT trading volume is provided by liquidity provision strategies .

These other two strategy types exist as long as markets exist

Short term momentum-strategy

- New information leads to new price levels.
- These strategies attempt to generate profits by reacting swiftly to new information.
- As a result, new information is reflected in the market prices extremely quickly.
- Besides new information, market moves can generate trading signals (“riding the short term trend”).
- **Primary source of income: Short term shift in general price level.**

Liquidity detection-strategy

- Detection of hidden orders or orders that are generated by execution algorithms.
- The aim is to gather information about the direction of the customer flow and thus the market prices.
- Often used by electronic liquidity providers in order to recognize the market direction at an early stage.
- **Primary source of income: To take advantage of short term trends or avoidance of losses when providing liquidity.**

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Speed is a risk management tool for participants

A Market Maker's quote...

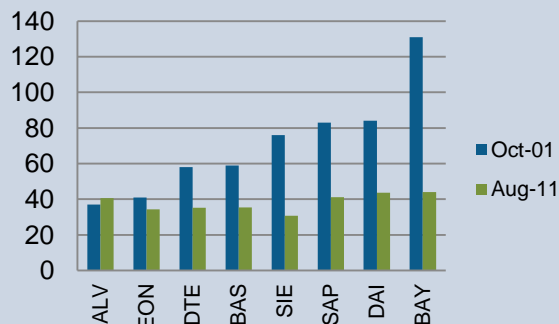
- ...is valid until cancelled.
- ...needs to be updated when the information changes.
- ...results in exposure/risk for the time until the existing quote is either updated or cancelled at the exchange.

The higher the speed...

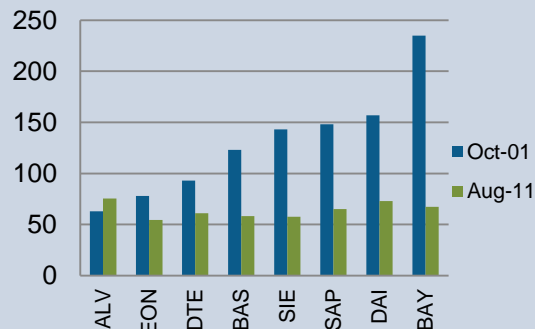
- ...the more immediate the transfer of risk.
- ...the more liquidity the Market Maker is prepared to offer.
- ...the tighter the bid-ask spread the Market Maker is willing to quote.

**Reduction in
frictional
costs
to end-users**

XLM (bp) – order size €1MN



XLM (bp) – order size €2MN



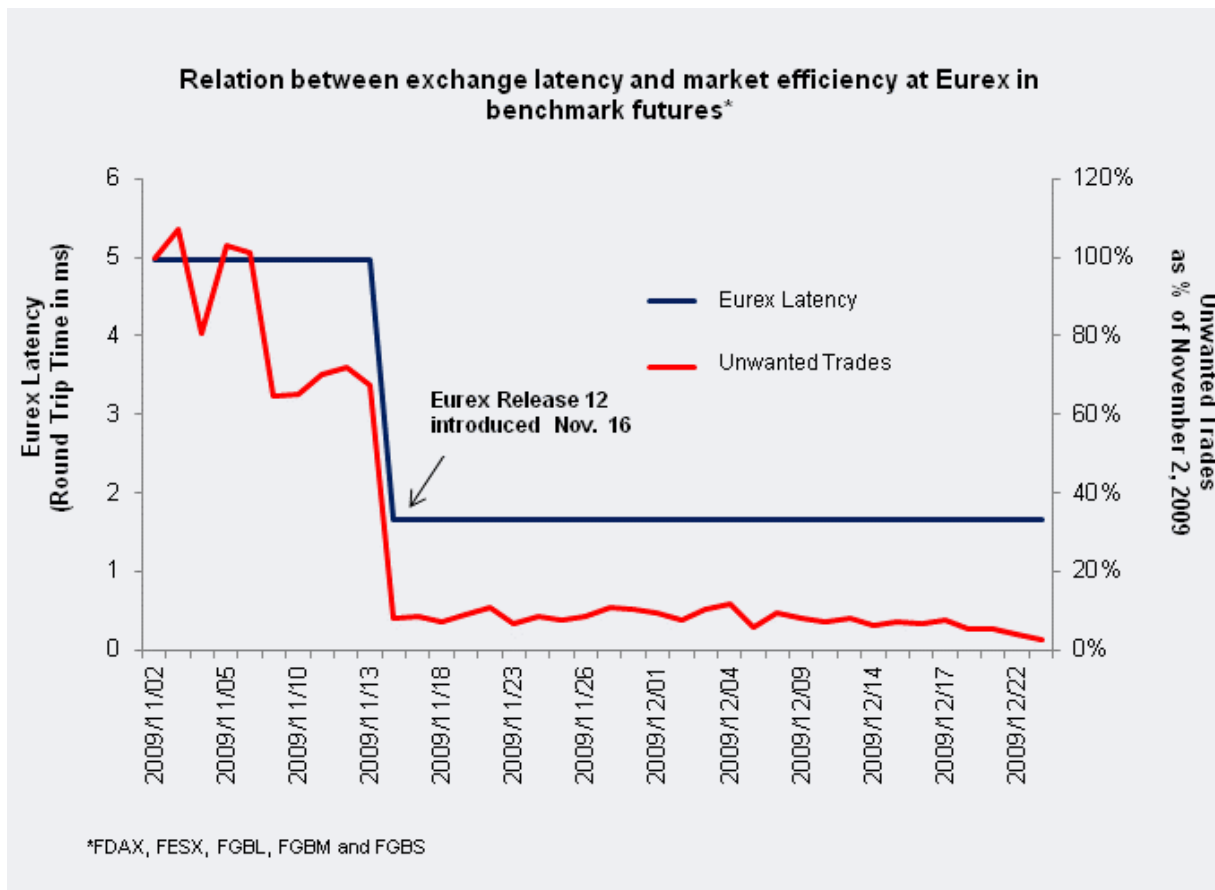
Reduction in exchange latency improves situation of liquidity providers which leads to better market quality

The biggest risk for liquidity providers is that new information implies new price levels and the liquidity provider is not able to update its quotes before others take advantage of the outdated quote.

The indicator for this is the number of "unwanted trades": We measure it by the number of times, when one party sought to modify/delete its order/quote, but it is was already matched.

Evidence from Eurex Exchange shows that a significant reduction in exchange latency in 2009 has lead to a massive reduction of the number of unwanted trades.

This enables the liquidity providers to provide higher quote quality in terms of spread and size to the market.



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Explicit transaction costs decreased substantially for European institutional investors through technical advancement

- The share of high touch order execution decreased drastically in the last few years through the increase in the availability technology. At the same time, the cost of high touch executions was cut in half.
- No touch (DMA) occurs at very low cost and accounts now for approximately 80% of total execution.

Method of execution	2000		2005		2011	
	% trades	fee (bps)	% trades	fee (bps)	% trades	fee (bps)
High touch	100%	25-40	70%	15-20	20%	10-15
No touch (DMA)	N.A.		30%	7-8	80%	1-3

Source: IMC estimation

... part of the reduced cost results from decreasing market infrastructure fees

- Reduction in the costs of trading in all major financial centers (weighted average decrease of 21%).
- The cost of trading corresponds to the sum of fees charged by:
 - **Trading platforms**
 - Central counter-parties (**CCP's**)
 - Central Securities Depositories (**CSD's**)

Domicile of securities	Cost of trading (bp) in 2006	Cost of trading (bp) in 2009	% change
All financial centres			
Weighted average	8.9	7.0	-21
Major financial centres			
Weighted average	9.4	7.6	-19
France	11.0	9.1	-18
Germany	9.2	7.2	-21
Italy	8.0	4.1	-48
Spain	9.2	6.9	-25
Switzerland	8.2	7.4	-10
UK	9.3	8.1	-12
Secondary financial centres			
Weighted average	9.1	7.9	-13
Other financial centres			
Weighted average	10.9	8.8	-19

Source: Monitoring prices, costs and volumes of trading and post-trading services by Oxera, May 2011.

Liquidity varies over time, largely dependent on economic uncertainty

Eurex Liquidity Measure (ELM)

The ELM measures the round trip market impact cost of somebody executing a EUR 10 million market order on exchange.

It is a proxy for liquidity. The smaller the price impact, the higher the liquidity.

At times of crisis, the market impact cost increases, as participants scale down their risk profile, resulting in wider spreads and reduced sizes.

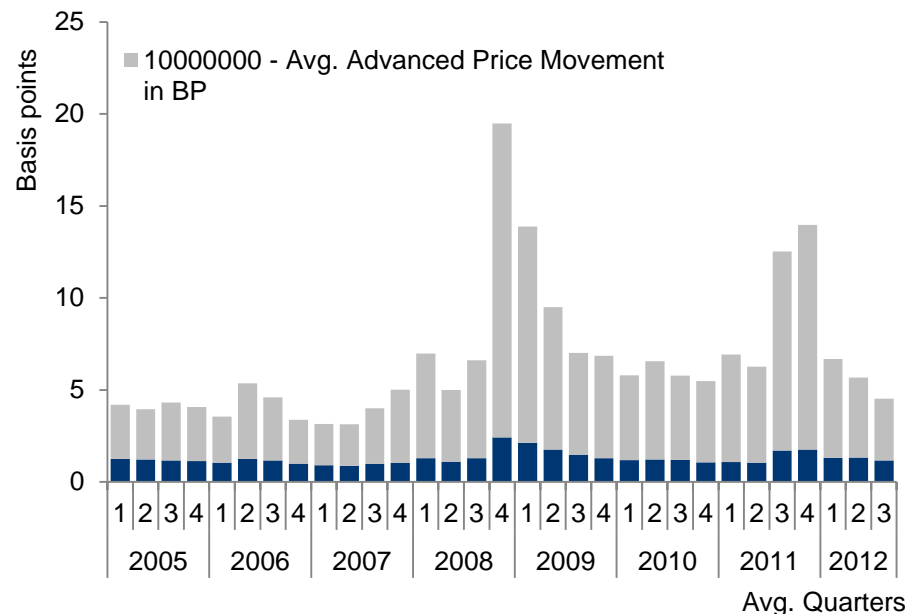
In general, the liquidity readily available in the order book looks slightly worse in Q3 2012 than in 2005.

One of the key contributors to this trend is the use of execution algo by the buy-side, which has vastly reduced the placement of resting orders by the buy-side in the transparent order book.

HFT adds significant liquidity, but their order sizes are typically much smaller.

Visible liquidity decreased

Liquidity did not revert back to its high of Q2 2007.



... however, the market has become much more resilient

How to quantify liquidity resilience?

Fierce competition in liquidity provision strategies, using HFT technology, increased the resilience of liquidity in our benchmark futures.

The top chart shows a stylized example of the spread recovery following a large aggressive order.

The time it takes the liquidity to recover is a function of (a) volatility (b) order size and (c) competition for liquidity provision.

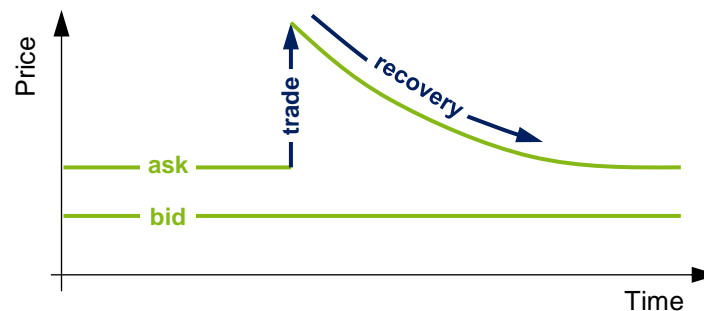
By accounting for (a) and (b) it should be possible to say something about (c). The bottom graph shows average recovery paths for eight similarly volatile days; four from 2010 and four from 2012.

We see a tremendous increase in resiliency compared to 2010, implying increased competition for liquidity provision.

We argue that the increase in resiliency makes up for (part of) the reduction in visible liquidity.

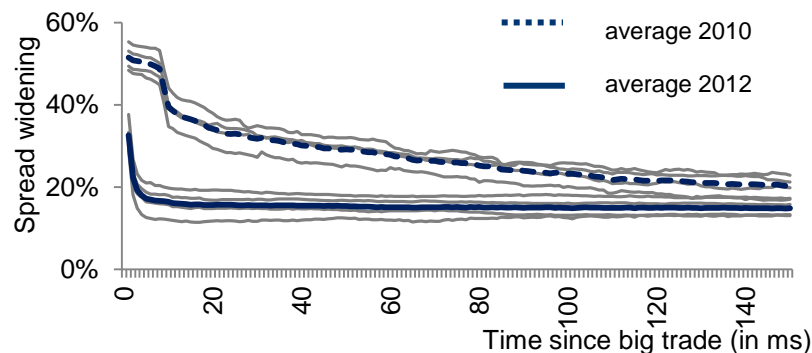
How to quantify liquidity resilience?

We focus on the recovery period after a big trade (in the case below; a buy) widened the spread.



Evidence of resilience improvement

Compared to 2010, the liquidity in the DAX futures became much more resilient. The averages converge around 500ms from the big trade.



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What does volatility mean and what does it cause?

Volatility is a measure of price variation of an instrument.



It reflects the uncertainty about the future price of an asset or the market as a whole.

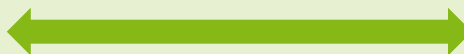


It is **amplified** by the breadth of possible outcomes.



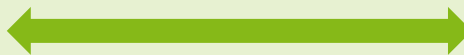
Possible outcomes

Inflation



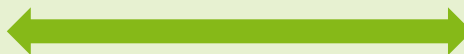
Deflation

Growth



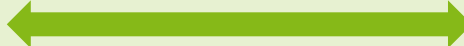
Recession

Fiscal consolidation



Sovereign default

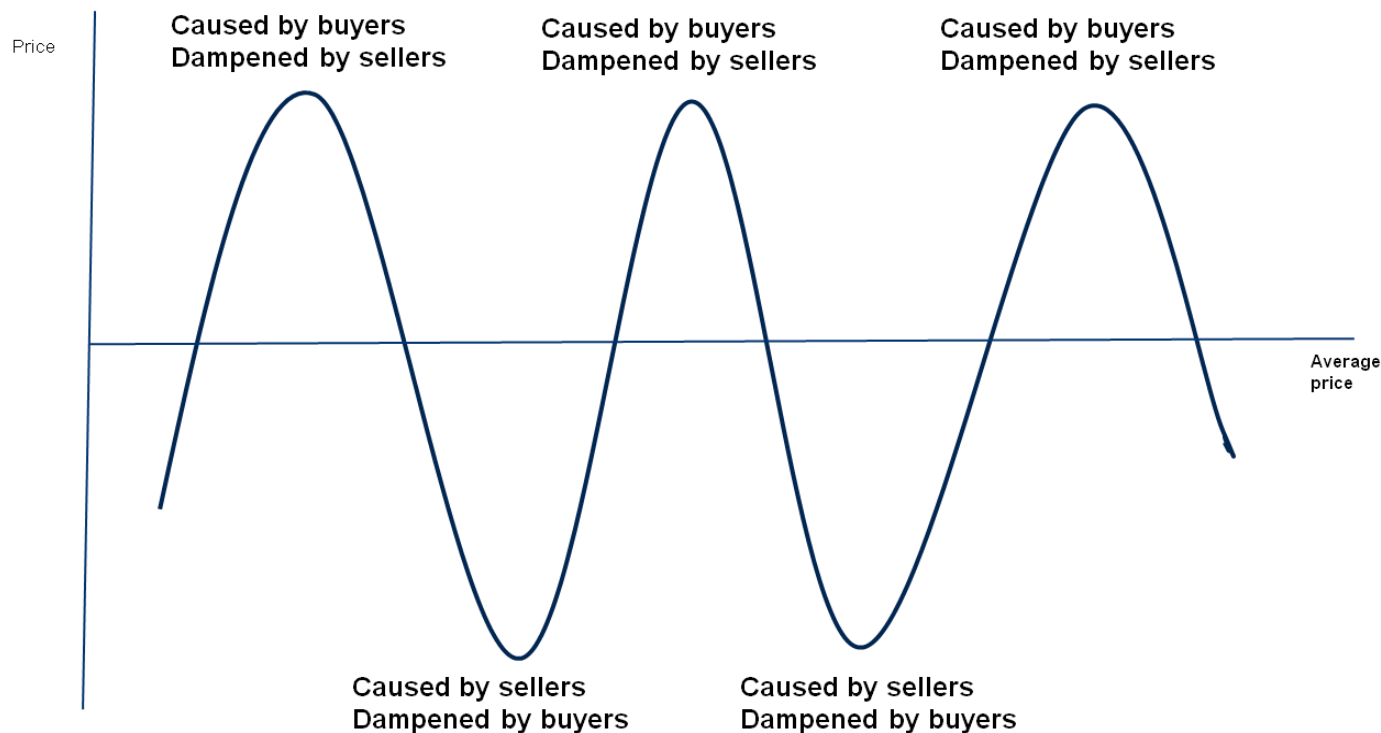
Strengthening the EUR by reforms



Breakdown of the EUR

HFT strategies typically benefit from volatility, but do not increase it

- HFT strategies are intraday strategies.
- Mean reversion is the basic strategy of most liquidity providers/Market Makers.



What does research say?

HFT dampens volatility

- Credit Suisse (2010)
- CME Group (2010)
- Brogaard (2011)
- Castura, Litzenberger, Gorelick, Dwivedi (2009)
- Hasbrouck and Saar (2011)
- Hagströmer, Nordén (2012)

HFT has no effect on volatility

- Chaboud, Chiquoine, Hjalmarsson and Vega (2009)
- Frino, Lepone, Mistry (2010)
- Hendershott and Riordan (2009)
- UK Treasury Foresight Committee (2011)
- Groth (2010)
- Bank of international Settlements (2011)
- Jarnecic, Snape (2010)

HFT causes volatility

- Zhang (2010)
- Boehmer (2011)

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The accusation of front running is misleading and false

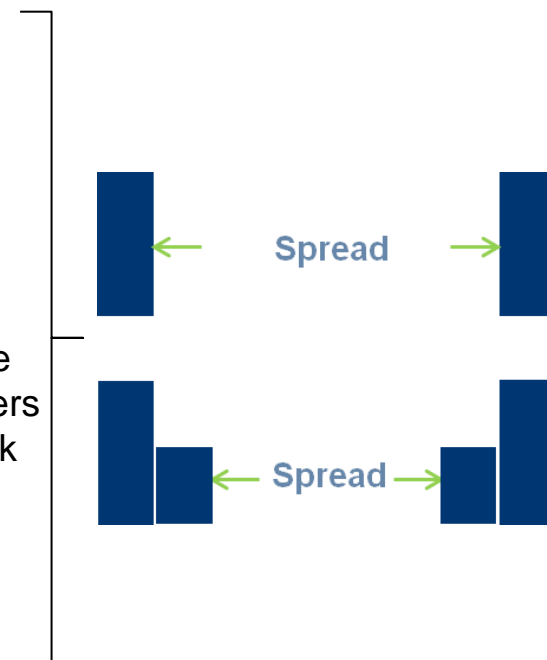
- In public discussions, the accusation is that, from time to time, HFT firms pursue front running of customer flow
- This accusation is wrong. By definition, they are not able to pursue front running: they do not have customer flow and therefore, no private order flow information that they could abuse.

If the accusation of front running is incorrect, where does it come from?

- Usually, institutional investors have large orders, which they execute with the help of algorithms over time to minimize the market impact (implicit transaction cost).
- In contrast, numerous HFT firms are liquidity providers.
- The greatest threat to a liquidity provider is that one or several large orders move the market. This created losses for the liquidity provider, as they are the first counterparts to the large order and thereafter the market moves against them due to the large order size.
- To compete successfully in the market, liquidity providers need to identify, as quickly as possible, when the market moves in a certain direction through large orders (usually generated by institutional customers).
- Liquidity providers may witness price changing orders through liquidity detection strategies only, after parts of this order are present in the market and have already been filled.
- This leads to a natural conflict which always existed: Large orders shift the market and institutional investors try to keep the impact as small as possible. To achieve this goal, they have to work off the orders as inconspicuously as possible. If they succeed, liquidity providers will be damaged who in turn, use liquidity detection strategies, for their protection.
- Liquidity providers at no point of time, have the knowledge about the size of the original order, not to mention any other private information necessary for front running.

Tighter spreads reduce “bid-ask sizes”, and thereby create the perception of reduced liquidity

- Electronic trading has tightened the average bid-ask spread.
- This development was amplified by a number of markets reducing the tick size in response to the tightening of spreads.
- As a result of both factors, the quantities available at the best bid-ask have become smaller in many markets. Institutional investors perceive this as a reduction of liquidity as they reluctantly trade through the best bid-ask.
- A major driver for smaller displayed size in the order book has been the institutional investors themselves, as they hardly place any resting orders in the public order book due to the use of execution algorithms and dark pools.
- This negative effect on liquidity has been compensated for by growing HFT participation, as evidenced by improved liquidity.



In futures contracts, there is no evidence of HFT orders fading away when large orders hit the market

Introduction

Some buy-side firms complain that the liquidity seen in the public order book is not really available to them. In this respect, HFT is also accused of front running.

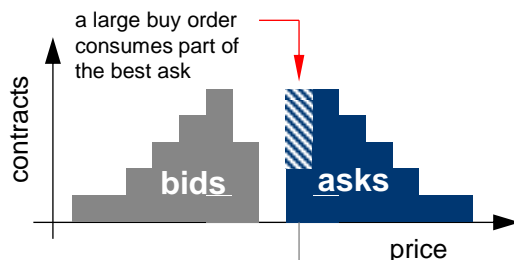
This allegation is obviously related to the experience in fragmented (cash) markets, where sometimes a buy-side order, by the time it hits the second or third market is meeting an order book where some of the liquidity providers responded faster to the fills in the first market.

Our analysis of futures revealed:

- a) there is no evidence of HFT pulling out before large orders hit the market and
- b) right after a large order has hit the market, the HFT-share of the just hit best bid or just hit best offer is increasing above the average participation level.

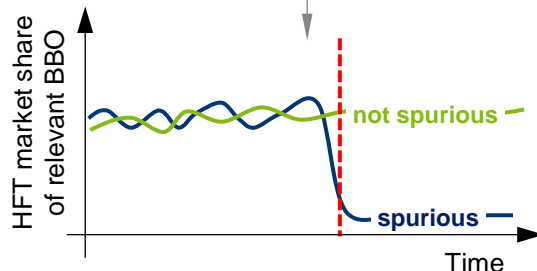
How to quantify spuriousness?

Retreating liquidity is especially painful around large trades (when liquidity is already under stress).



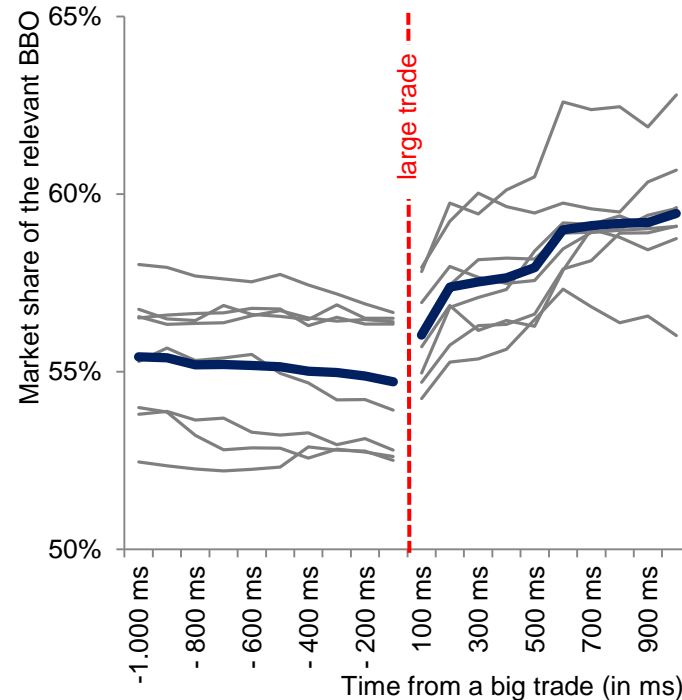
What do we expect?

Finding a liquidity reduction after a large trade is not enough. We're interested in evidence of HFTs pulling out more than non-HFTs before or after a large trade.



Actual HFT participation

The grey lines depict the daily average market share of HFTs on the relevant side of the BBO before and after a large trade (10 times the trailing 10 minute average) in the front month EURO STOXX 50@ futures.



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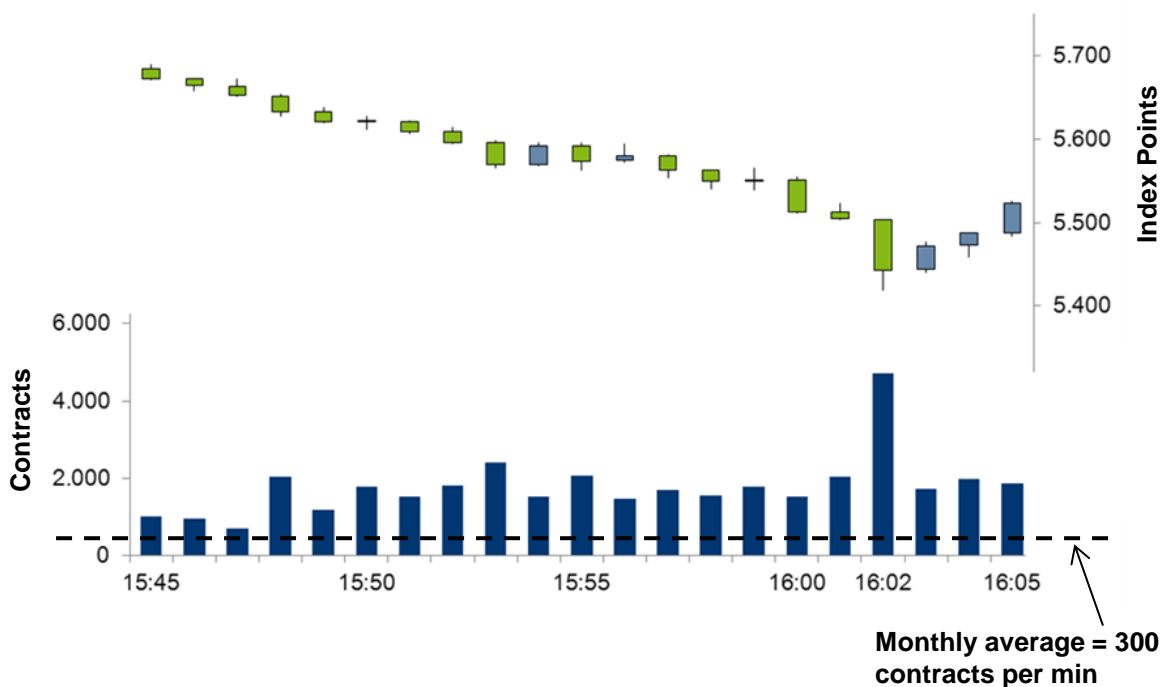
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25 August 2011: Within a few minutes institutional orders caused a rapid decline in prices: highly liquid order book damped price impact

Trading in FDAX contracts on 25 August 2011 (one-minute intervals)



Description

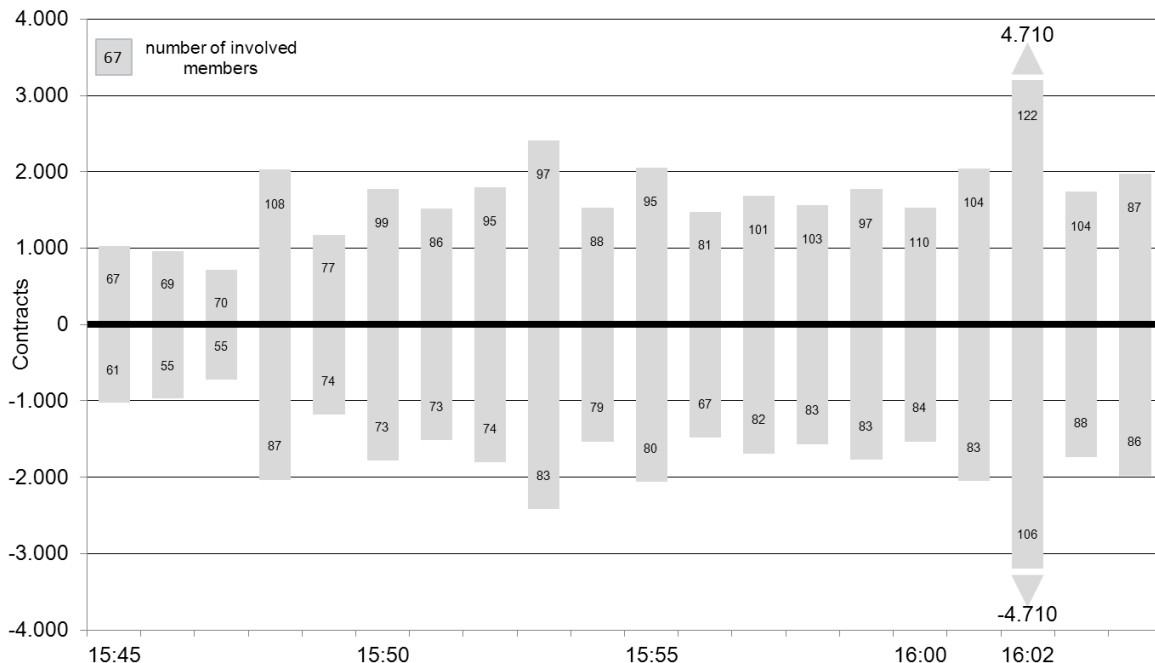
Within 17 minutes the FDAX went down by more than 4%, and came back by 2%.

Cause of the price decline: a big institutional order (6,000 contracts), which was converted by algorithms into a large number of sell orders flooding the market during that time.

Highly liquid order book prevented a greater decrease: high volume orders were processed with only small price increments- peak turnover 4,700 contracts per minute, compared to monthly average of 300 contracts per minute.

Large number of buyers absorbed the initial shock; HFTs provided liquidity, since they were buying in falling markets

Number of individual buyers and sellers per minute



Description

High number of trading participants involved on both sides of the market shows high variety of trading interests.

A total of around 200 different trading participants acted as buyers in the falling market, including but not limited to high-frequency traders.

High liquidity was in large part provided by HFTs, as these participants initially absorbed the major sell positions and then passed them on to protect the market. The often assumed acceleration of downward movements through computer-based trading strategies was not observed.

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Regulation of algorithmic and high-frequency trading is in the scope of MiFID II (1)

		EU Commission legislative proposal	European Parliament amendments	European Council amendments
Algorithmic / high-frequency trading	Art. 2.1 (d) MiFID <i>Regulation and Supervision of HFTs</i>	HFTs to be supervised and regulated under MiFID II	HFTs to be supervised and regulated under MiFID II	HFTs to be supervised and regulated under MiFID II
	Art. 4 MiFID <i>Algorithmic Trading / HFT / HFT Strategy Definition</i>	Definition for algorithmic trading No definition for high-frequency trading	Definition of algorithmic trading (30) / HFT (30a) and of HFT strategy (30 b). HTF strategy is based on two out of five criteria*	Definition of algo trading (30) / and of high-frequency algo trading strategy (30 a). The latter is characterized by three criteria**
	Art. 17.3 MiFID <i>Liquidity Provision</i>	Continuous liquidity provision for algorithmic trading strategies (firm quotes at all times)	Applies only for those investment firms that are engaged in market making (scheme set by market venue)	Applies only to those investment firms that follow a market making strategy
	Art. 17.1 MiFID <i>Risk controls</i>	Investment firm that engages in algorithmic trading shall have in place effective systems and risk controls (Art. 17.1)	Investment firm shall have in place effective systems and controls (Art. 17.3)	Investment firm that engages in algorithmic trading shall have in place effective systems and risk controls (Art. 17.3)

* 'High-frequency trading strategy' means a trading strategy for dealing on own-account in a financial instrument which involves high-frequency trading and has at least two of the following characteristics: (i) it uses co-location facilities, direct market access or proximity hosting; (ii) it relates to a daily portfolio turnover of at least 50 %; (iv) the proportion of orders cancelled (including partial cancellations) exceeds 20 %; (v) the majority of positions taken are unwound within the same day; (vi) over 50% of the orders or transactions made on trading venues offering discounts or rebates to orders which provide liquidity are eligible for such rebates.

** 'High-frequency algorithmic trading strategy' means an algorithmic trading strategy characterised by: infrastructure intended to minimise network and other types of latencies including proximity and co-location; system determination of order initiation, generating, routing and execution without human intervention for each individual trade or order; high message rates (orders, quotes or cancellations).

Regulation of algorithmic and high-frequency trading is in the scope of MiFID II (2)

		EU Commission legislative proposal	European Parliament amendments	European Council amendments
Algorithmic / high-frequency trading	Art. 51 a MiFID <i>Minimum Order Resting Time</i>		Introduction of a minimum order resting time of 500 milliseconds to slow down trading	
	Art. 51.3 MiFID <i>Ratio of unexecuted orders to transactions</i>	Slow down of order flow through limit of ratio of unexecuted orders to transactions	Slow down of order flow through limit of ratio of unexecuted orders to transactions	Slow down of order flow through limit of ratio of unexecuted orders to transactions
	Art. 51.5 a MiFID <i>Order cancellation fee</i>		Higher fee for placing an order that is subsequently cancelled than an order which is executed	
	Art. 51.6 MiFID <i>Order flagging</i>			Flagging orders generated by algorithmic trading, the different algorithms used for the creation of orders and relevant persons initiating these orders

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Announcement of German HFT Bill to be expected in May 2013



30 Jul 2012	Publication of Discussion Paper for Participation of Organizations
17 Aug 2012	Consultation Deadline for Departments and Organizations
26 Sep 2012	Decision Bundeskabinett (Federal Cabinet)
23 Nov 2012	First Review Bundesrat (Upper House of German Parliament) (incl. statement)
29 Nov 2012	First Reading Bundestag (Lower House of German Parliament)
16 Jan 2013	Hearing in Financial Committee of the Bundestag (Lower House of German Parliament)
30 Jan 2013	Consultation in the Bundestag Financial Committee
27 Feb 2013	Final Consultation in the Bundestag Financial Committee
28 Feb 2013	Second and Third Reading Bundestag (Lower House of Parliament)
22 Mar 2013	Second Review Bundesrat (Upper House of German Parliament)
May 2013	Announcement of German HFT Bill (expected)

German HFT Bill foresees several measures and procedures to regulate algorithmic trading and HFT

Main Aspects:

- 1 Additional rights for the Exchange Supervisory Authority/BaFin
- 2 Price discovery protection (e.g. volatility interruptions)
- 3 Requirements to set appropriate tick sizes
- 4 Organizational requirements for investment firms (IFs)
- 5 Order to Trade Ratios (OTR); Excessive System Usage Fees (ESU-Fee)/ Transaction Limits
- 6 Flaggering of algorithmically generated orders
- 7 Registration obligation as Financial Service Institutions

Deutscher Bundestag

Drucksache 17/12536

17. Wahlperiode

27. 02. 2013

Beschlussempfehlung und Bericht

des Finanzausschusses (7. Ausschuss)

zu dem Gesetzentwurf der Bundesregierung
– Drucksachen 17/11631, 17/11874 –

Entwurf eines Gesetzes zur Vermeidung von Gefahren und Missbräuchen im Hochfrequenzhandel (Hochfrequenzhandelsgesetz)

A. Problem

In den letzten Jahren hat aufgrund technologischer Entwicklungen und im Zuge des zunehmenden Wettbewerbs zwischen Finanzplätzen durch Schaffung neuer Arten von Handelsplattformen der elektronische Handel von Finanzinstrumenten zunehmend an Bedeutung gewonnen. Bestimmte Handelsteilnehmer setzen beim elektronischen Handel algorithmische Handelsprogramme ein, die Kauf- und Verkaufssignale in sehr kurzen Abständen von teilweise nur einigen Sekundenbruchteilen generieren und das Halten von Finanzinstrumenten nur für sehr kurze Zeiträume vorsehen. Hierbei handelt es sich um den sog. Hochfrequenzhandel.

Der Einsatz dieser algorithmischen Hochfrequenzhandelsstrategien hat die Geschwindigkeit und Komplexität des Handels erhöht und birgt darüber hinaus eine Vielzahl von Risiken, wie die Überlastung der Handelssysteme in Form einer übermäßigen Nutzung durch ein sehr hohes Orderaufkommen. Daneben besteht das Risiko, dass algorithmische Handelsstrategien auf andere Marktereignisse überreagieren, was die Volatilität erhöhen kann. Schließlich können durch den Hochfrequenzhandel bestimmte Formen von missbräuchlichem Verhalten entstehen.

B. Lösung

Mit dem Gesetzentwurf wird angestrebt, den besonderen Risiken des algorithmischen Hochfrequenzhandels entgegenzuwirken, indem mit der Erweiterung der Definition des Eigenhandels um den Hochfrequenzhandel eine Aufsichtslücke geschlossen und die Hochfrequenzhändler unter die Aufsicht der Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) gestellt werden.

Zudem sollen strengere Anforderungen an den algorithmischen Handel gestellt werden. Wertpapierdienstleistungsumnehmern, Kapitalanlagegesellschaften und selbstverwaltende Investmentaktiengesellschaften, die den algorithmischen

Additional rights for supervisors, protection of price discovery process and appropriate tick sizes

Topic	Description
1 Additional rights for supervisors	<ul style="list-style-type: none">Supervisors (Exchange Supervisory Authority and BaFin) are allowed to request information about algorithmic trading, the used systems, and a description of strategies or parameters, wherever grounds for checks with one of the provisions that are covered in the bill.Supervisors are allowed to prohibit algo trading strategies.
2 Protection of price discovery process	<ul style="list-style-type: none">Exchange* has to ensure that orderly price discovery is granted even in situations of large price fluctuations (changes of market model, volatility interruptions under consideration of static or dynamic price corridors or limit control systems).
3 Set Tick Sizes	<ul style="list-style-type: none">Exchange has to ensure an appropriate tick size to prevent adverse effects on market integrity and liquidity.When determining tick sizes, Exchange needs to consider that the price discovery mechanism and the goal of reaching a suitable OTR are not affected.Further provisions can be delivered by Exchange Rules.*

* Similar for MTF

Organizational requirements required for investment firms that use algorithmic trading and introduction of ORTs and fees for excessive system usage

Topic	Description
<p>4 Organizational requirements for IFs</p>	<p>Securities Trading Act § 33 (1a)</p> <p>Applies for investment firms that use algorithmic trading. The firm must facilitate system and risk controls in order to ensure</p> <ol style="list-style-type: none"> 1. its trading systems are resilient, have sufficient capacity and are subject to appropriate trading limits 2. that orders are not transmitted erroneously or a malfunctioning of the system is avoided, which would cause disruptions on the market or would contribute to these disruptions. 3. its trading systems cannot be used for a purpose that is contrary to the European or national rules preventing market abuse or the regulations of a trading venue to which it is connected. <p>The firm must further have in place emergency measures in order to deal with unforeseen disruptions in its trading system and ensure that its system are fully tested and orderly surveilled. It must also ensure that every change of a computer algorithm used for trading is documented.</p>
<p>5 Order to Trade Ratios and Excessive Usage Fee</p>	<p>Exchange Act § 26a and § 19</p> <ul style="list-style-type: none"> • Participants are required to ensure suitable Order-to-Trade Ratio (OTR). • OTR tbd. by Exchange Rules*; per instrument; per month, per function of trading participant, per asset class <p>Exchange Act § 17</p> <ul style="list-style-type: none"> • Introduction of Excessive System Usage-Fee. • Fees tbd. by Management Board of Exchange

Order flagging required for orders generated by investment firms' computer algorithms

Topic	Description
6 Algorithmic trading defined	Securities Trading Act § 33 (1a) <ul style="list-style-type: none">• An investment firm• Trading in financial instruments• Order parameters are determined automatically by a computer algorithm• Parameters include decisions<ul style="list-style-type: none">– to initiate the order– on time, price or quantity of the order– or how the order should be processed after its initiation, whereas it involves limited or no human interaction Exemptions: <ul style="list-style-type: none">• Systems that merely route orders• Systems that confirm orders
6 Labeling of algorithmic orders	Exchange Act § 16 (2) (c) <ul style="list-style-type: none">• Designation of orders that are generated by Algorithmic Trading by trading participants and• Identification of the respectively used trading algorithms

License for firms under German Banking Act needed if they perform “High-frequency algorithmic trading” on own account

7 English convenience translation (non binding):

Article 2: Extension of banking act (Section 1 paragraph 1a Sentence 2 number 4) by following financial service:

- d) „ The purchase or sale of financial instruments **on own account** as a direct or indirect participant of a domestic organised market or multilateral trading system via **high-frequency algorithmic trading technologies**, which are characterized by **the usage of infrastructures that intend to minimize latency**, as well as **systems creating, transmitting and executing an order without any human intervention for single trades or orders and quotes**, and by a **high intraday message amount in form of orders, quotes or cancellations** also without providing services for others (proprietary trading).”



BaFin revealed criteria*

‘Latency minimizing infrastructure’

Only use of fastest connectivity option, i.e. 10 Gbit connection in co-location

‘High intraday message rate’

Daily threshold of 75,000 messages (order entries, quotes, deletions, modifications) per member (to be converted into an annual figure); separate for Xetra and Eurex

Passporting of license in order to continue trading on a German trading venue

Issue	Description
7 EEA*-based firms	
With permission for “dealing on own account”	<ul style="list-style-type: none"> • If not already passported to Germany: Need to passport their license to Germany via home supervisor • If already active in Germany with European passport: No additional license needed (merely notification)
Without permission	<ul style="list-style-type: none"> • Need to get license from home supervisor and then passport the license • Alternative: Set up branch in Germany and get a license
7 Non-EEA*-based firms	
With permission similar to MiFID’s “dealing on own account”	<ul style="list-style-type: none"> • No information provided in bill
Without permission	<ul style="list-style-type: none"> • No information provided in bill

*EEA = European Economic Area (EU countries plus Iceland, Liechtenstein and Norway)

Transitional Periods are granted for firms that are not yet regulated for HFT

Issue	Description
<p>7 EEA-based firms</p> <p>With permission for “dealing on own account”</p>	<ul style="list-style-type: none"> • Application for passporting is filed with home supervisor within six months
<p>Without permission</p>	<ul style="list-style-type: none"> • After license has been obtained: application for passporting is filed with home supervisor within six months • Alternative (Set up branch in Germany): complete application is filed with BaFin within nine months
<p>7 Non-EEA-based firms</p>	
<p>With permission similar to MiFID’s “dealing on own account”</p>	<ul style="list-style-type: none"> • Complete application is filed with BaFin within nine months (branch to be set up first)
<p>Without permission</p>	<ul style="list-style-type: none"> • Complete application is filed with BaFin within nine months (branch to be set up first)

Summary

HFT is a natural evolution resulting from technological developments and competition

- HFT is a natural reflection of competition between market participants using the advances in computer technology.
- HFT is a technology that enables for the implementation of a wide range of trading strategies.
- All actors in financial markets need to address this natural development
 - Proprietary traders/Market Makers: Implementation of speed-sensitive strategies requires constant and significant technology investment.
 - Brokers: Address customer needs for faster and more advanced execution of customer orders in a growing number of electronic markets.
 - Exchanges: Invest in faster systems with larger capacity and a variety of safety mechanisms.
 - Regulators: Provide a framework for fair and transparent markets. Receive more information than ever to monitor the markets. Challenge is the efficient use of the large amount of data.
- A “deceleration of the markets” by regulatory intervention is not a solution.
 - Either the markets go somewhere else or the actors find ways of bypassing.
- As a result of public pressure the risk of over-regulation for HFT is high, as exemplified by the multitude of regulatory initiatives (MiFID, ESMA Systems & Control, national rules, e.g. German HFT Bill).

Thank you for your attention

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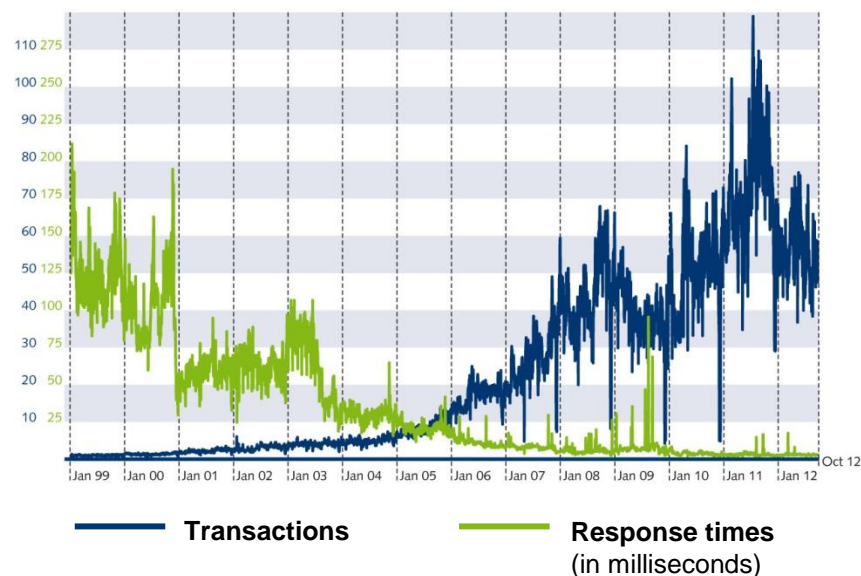
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Backup

HFT requires high investments in the exchange infrastructure

- Our trading and clearing systems have to process an exponentially growing number of technical transactions (message throughput).
- Eurex Exchange addresses this with the roll-out of a completely new trading architecture. The clearing architecture will be renewed as well.
- Furthermore, Eurex has massively invested in tools, which enable Eurex Exchange, Eurex Clearing, Exchange participants and Clearing Members to identify and address problems swiftly and independently.
- In addition to our investments in infrastructure and functionalities, we also protect the integrity of our marketplaces through a “transaction limit regime”, which provides participants with limits to their maximum system capacity usage. Violations trigger appropriate penalties.

Number of processed transactions at Eurex Exchange & response times

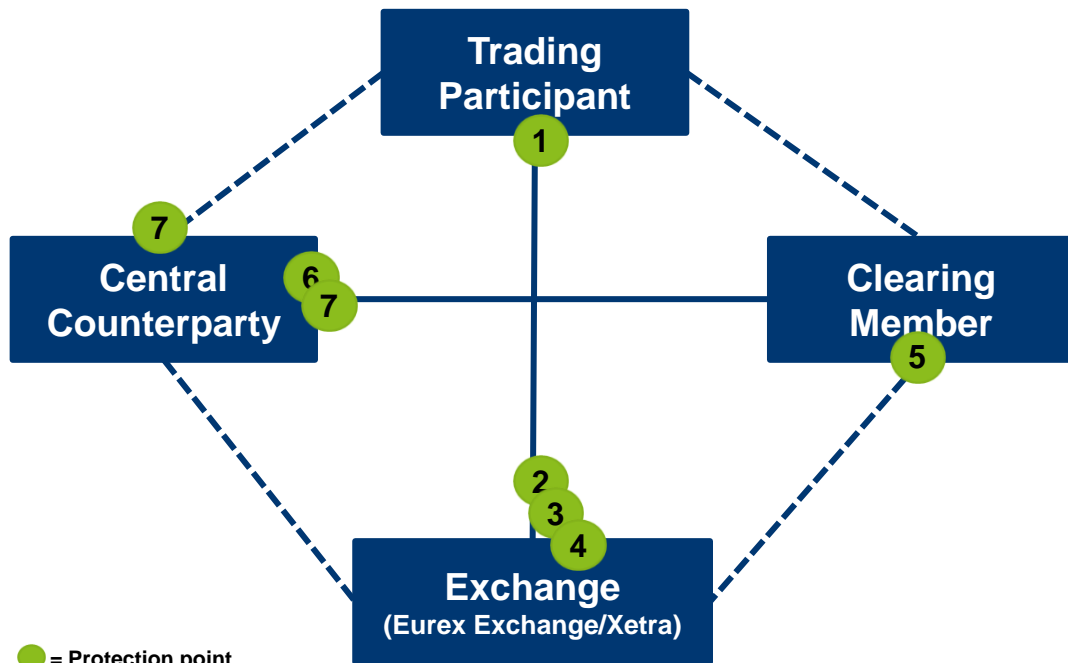


Risk of algorithms getting out-of control addressed by overlapping safety mechanism

- The overarching goal is the avoidance of a situation where an algorithm gets out of control and causes a serious market failure.
- This not only applies to HFTs but to all computer algorithms applied to our markets.
- Electronic exchanges such as Eurex Exchange have developed several tools to enable Exchange Participants, Clearing Members, Eurex Exchange itself and Eurex Clearing as the CCP, to identify and prevent possible misconduct as quickly as possible.
- In addition, trading participants and Clearing Members are also investing significantly into the monitoring of their algorithms in the dimensions of IT-governance, test protocols, access safety standards, risk monitoring and change management.
- HFT firms as well as exchanges such as Eurex Exchange welcome any regulatory definition regarding minimum standards for systems and controls.
- All parties have a keen interest in the integrity and efficiency of our markets.
- On the following pages there is an overview of the tools available at Eurex Exchange and Xetra.

Protection points across the value chain tackle potential risks arising from HFT

Illustration of major protection points at Eurex Exchange and Xetra



● = Protection point

Description

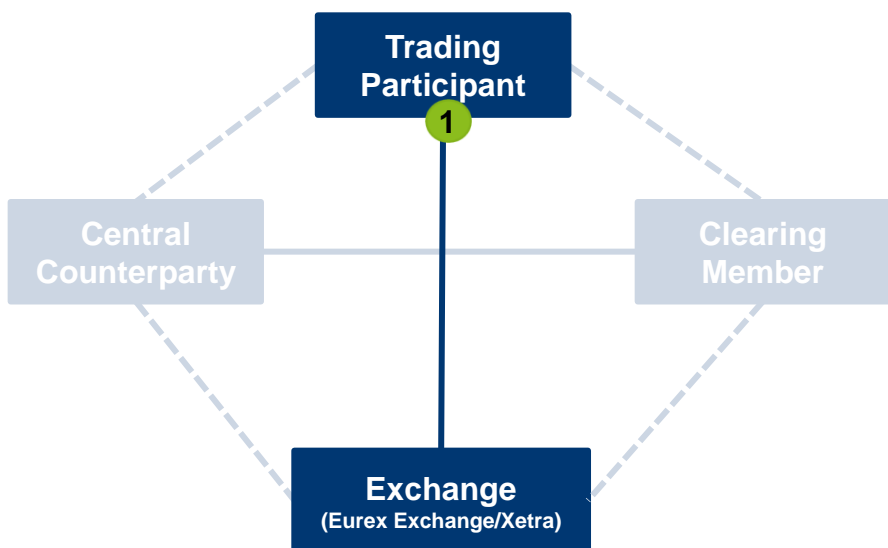
- | | | |
|---|---------------------------|-------------------------------------|
| 1 | DMA control | <input checked="" type="checkbox"/> |
| 2 | Plausibility checks | <input checked="" type="checkbox"/> |
| 3 | Architecture throttle | <input checked="" type="checkbox"/> |
| 4 | Trading safeguards | <input checked="" type="checkbox"/> |
| 5 | Stop button | <input checked="" type="checkbox"/> |
| 6 | Real-time risk management | <input checked="" type="checkbox"/> |
| 7 | Advanced Risk Protection | <input checked="" type="checkbox"/> |

- Protection mechanisms built into the market structure safeguard fair and orderly markets.
- Established procedures and practices exist to mitigate potential risks arising from trading / high-speed trading.
- Procedures exist along the whole value chain, involving traders, market operators, clearing firms and CCPs.
- Protection mechanisms handle errors on the level of order entry (“fat finger”), human mistakes or an erroneous algorithm.

Direct market access to Eurex Exchange/Xetra requires electronic control at the level of the firm

1 DMA control

Illustration



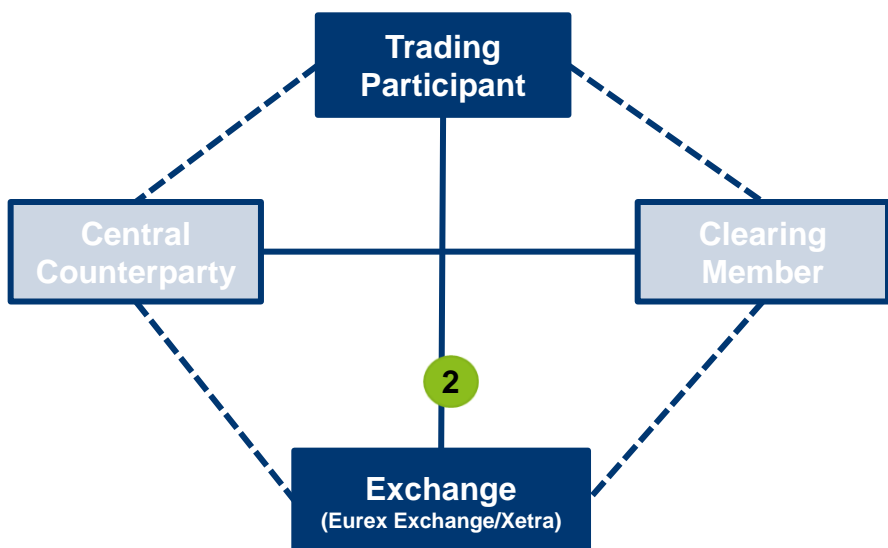
Description

- With Eurex Exchange/Xetra orders submitted by an order-routing system (DMA) pass an electronic filter installed at the company. The filter verifies all outgoing orders according to parameters pre-determined by the Exchange Participant.
- The firm has to inform the exchange (Eurex Exchange/Xetra) about the user ID of the Exchange trader under which the orders are entered.
- The exchange (Eurex Exchange/Xetra) may prohibit the connection of automated order-entry systems, if the connection jeopardizes the orderly exchange trading or system safety.

Plausibility checks at the exchange entry to prevent “fat finger errors”

2 Plausibility checks

Illustration



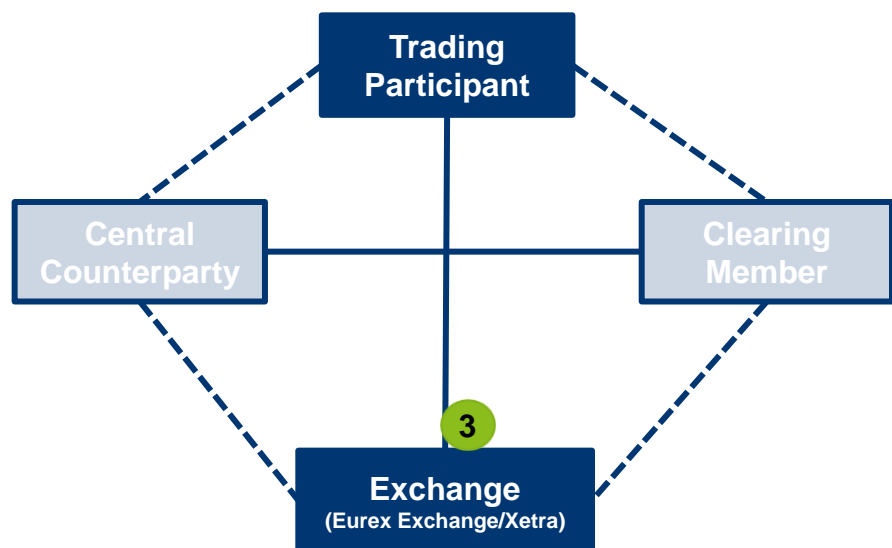
Description

- A fat finger error describes errors when inputting text via keyboard (typo).
- When entering an order, typos can have massive economic consequences (e.g. adding a “zero” to the order size will tenfold increase the size), if they are not prevented.
- Eurex Exchange/Xetra check for maximum order quantities upon reception of each order.
- Furthermore, Eurex Exchange/Xetra perform a mandatory check and offers an optional price reasonability check.

Architecture throttle limits the maximum message to avoid traffic congestion and resulting slow-down

3 Architecture throttle

Illustration



Description

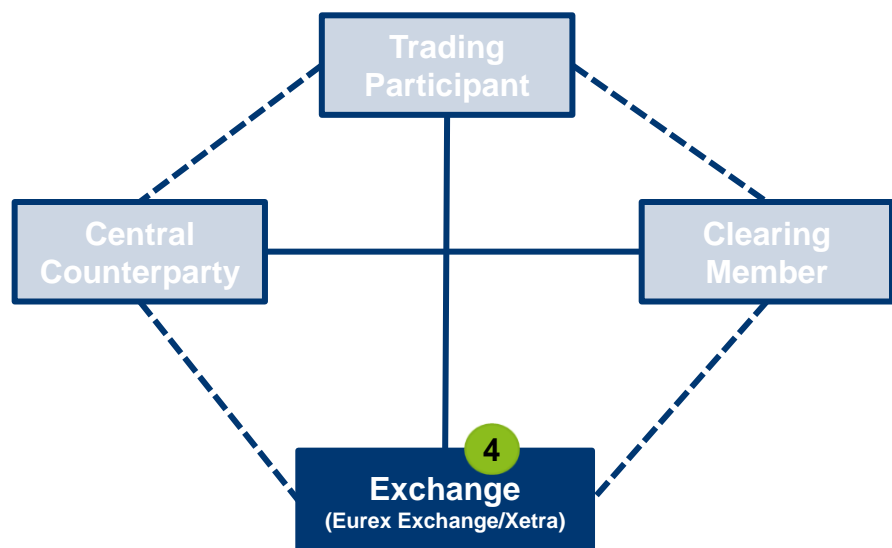
- Each trading session of a Participant includes a technical architecture throttle mechanism that limits the maximum throughput per second.
- The architecture throttle limits the transaction rates submitted per session. It avoids applications with extremely high transmission rates from endangering the overall integrity of the Eurex Exchange/Xetra trading system.
- The rate can be changed intraday, if market conditions require*.

* In addition to these measures, there are also limits for capacity usage rate for the members. They are enforced by an excessive usage fee. However, violations of the capacity usage limits are rare.

Trading safeguards as protection against extreme, unreasonable price moves

4 Trading safeguards

Illustration



Description

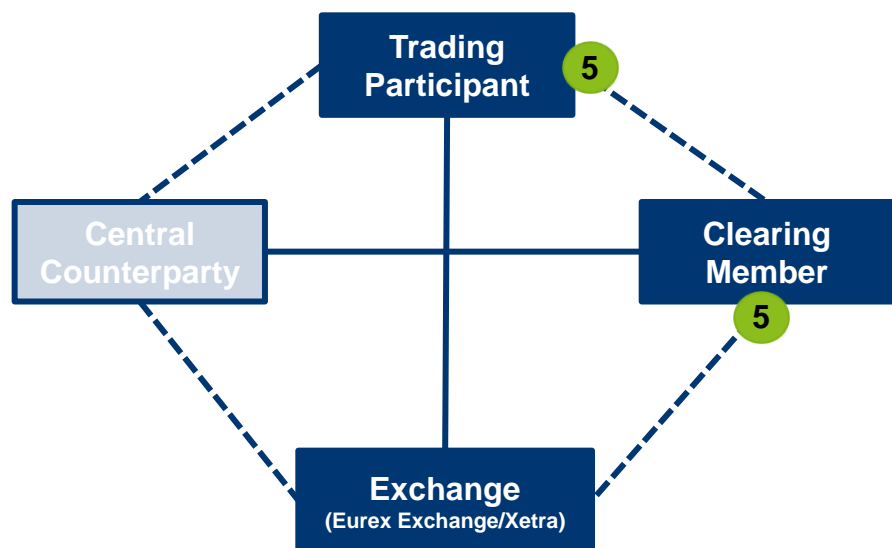
- Trading safeguards exist to protect the orderly price formation process.
- Trading safeguards at Eurex Exchange and Xetra are called “volatility Interruptions”.
- Trading is interrupted* “before the damage is done” – i.e. before a trade is made at volatile prices.
- For options markets, Eurex Exchange offers Market Maker protection tools to limit their risks.

* From a technical perspective, trading is not interrupted. Instead, the market model is merely switched from “continuous trading” to “call auction”. Therefore, the process of trading still resumes, as Participants can still delete, modify and enter orders in anticipation of the auction price.

Stop button enables Clearing Members to discontinue all trading activities of a Trading Participant

5 Stop button

Illustration



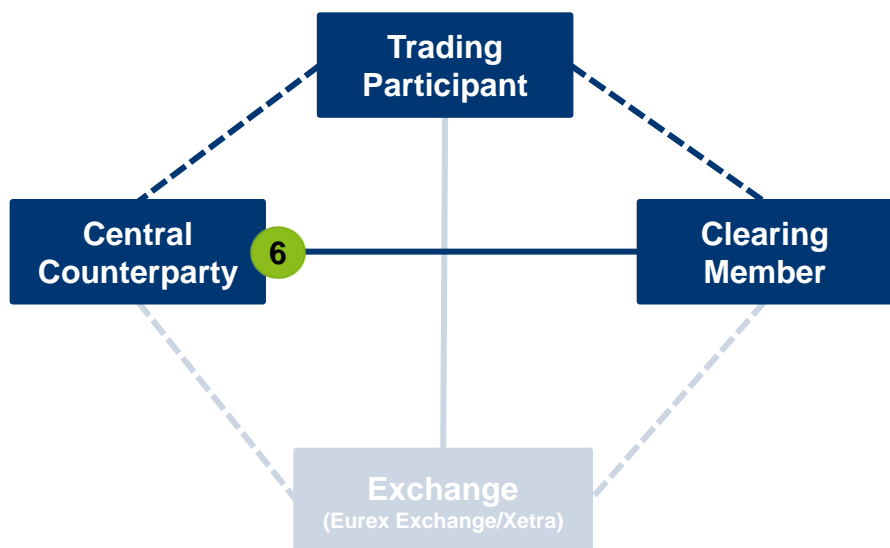
Description

- The stop button functionality enables Clearing Members to control (discontinue or release again) the transactions of their trading participants.
- At Eurex Exchange, this is also possible for trading participant.

Real-time risk and position information facilitate highly efficient risk management

6 Real-time risk management

Illustration



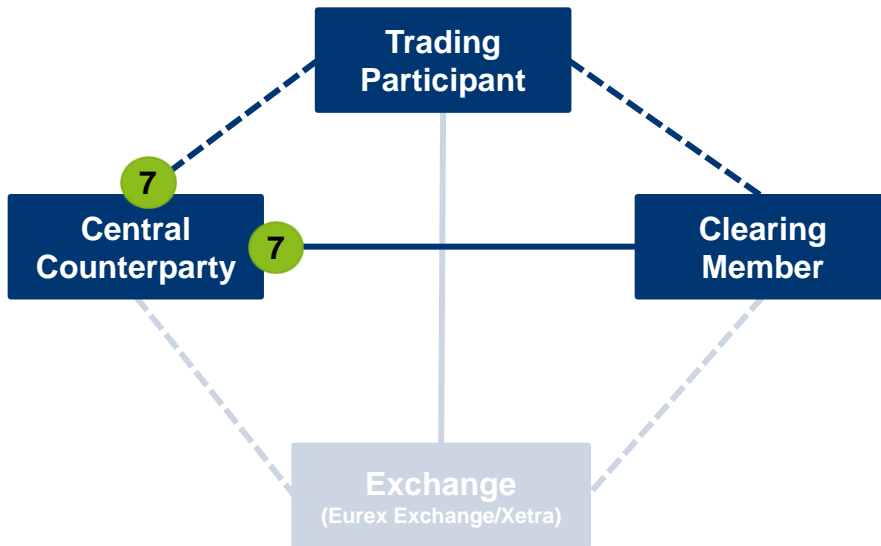
Description

- Real-time information on positions and resulting margin requirements is calculated and distributed throughout the trading day to Trading Participants and Clearing Members.
- Intra-day margining is an important feature of the risk management framework. It reduces the counterparty credit risk of the CCP because the intra-day margin call allows the CCP to quickly respond to increased price volatility or the growing positions of Clearing Members.

Protection mechanisms built into the market structure safeguard fair and orderly markets

7 Advanced Risk Protection

Illustration



Description

- Advanced Risk Protection functionality enables trading participants and/or Clearing Members to set up to three limits on aggregate risk metrics, such as the total margin requirement.
- Upon breach of the first limit, an alert message is sent.
- At the second limit, the system automatically throttles orders and quotes.
- At the third limit, the “stop button” functionality is automatically triggered, thus halting all trading activities.

Advanced Risk Protection: examples of risk limits and associated actions



Literature review (I/III)

Author(s) / Title	Dataset	Findings
Markets Committee, Bank for International Settlements (BIS) "High-frequency trading in the foreign exchange market", September 2011	Various FX venues, notably Reuters and EBS, and various dates, notably May 6, 2010 and March 17, 2011	HFT is found to be beneficial during normal market periods, with similar behavior to traditional market participants during high volatility periods
Brogaard "High frequency trading and its impact on market quality", August 2010	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
Brogaard "High Frequency Trading and Volatility", October 2011	HFT vs. other trades. U.S. equities on NASDAQ, various periods in 2008 – 2010	HFT activity tends to decrease idiosyncratic and intraday 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
UK Treasury Foresight Committee (2011) "The Future of Computer Trading in Financial Markets"	Literature review of computer based trading developments	Economic research thus far provides no direct evidence that high frequency computer based trading has increased volatility.

Literature review (II/III)

Author(s) / Title	Dataset	Findings
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
RGM Advisors (Castura, Litzenberger, Gorelick, Dwivedi) “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
X. Frank Zhang “The Effect of High-Frequency Trading on Stock Volatility and Price Discovery” November 2010	Firms from the Center for research in security prices (CRSP) and the Thomson Reuters Institutional Holdings databases during 1985–2009.	This study examines the effect of high-frequency trading on stock price volatility and price discovery
Boehmer, Fong, Wu (2012) “International evidence on algorithmic trading”	Large sample from 2001 – 2009 that incorporates 39 exchanges and an average of 12,800 different common stocks	We find that greater AT intensity is, on average, associated with more liquidity, whether measured at the transaction level or at the daily level, faster price discovery, and greater volatility

Literature review (III/III)

Author(s) / Title	Dataset	Findings
Hagströmer, Nordén (2012) “The diversity of high frequency traders”	NASDAQ OMX Stockholm, equity market, August 2011, February 2012	Market maker cause the biggest amount of HFT trading volume (63-72%) and limit order traffic (81-86%). Further Market maker have higher order-to-trade ratios, lower latency, lower inventory and provide liquidity more often than opportunistic traders