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AES Analysis

High Frequency Trading – The Good, The Bad, and The Regulation

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Key Points

- High Frequency Trading (HFT) is constantly in the spotlight and has attracted regulatory scrutiny.

- As HFT accounts for a significant portion of the market, it merits thorough and proper analysis in order to understand this behaviour and respond appropriately.

- Though HFT is often treated as a homogenous entity, there is in fact an enormous diversity of strategies.

- Many studies link HFT to improved market quality, but they do not isolate different strategies. It is possible that the largely positive effect of some HFT masks the negative consequences of others.

- Regulators and politicians have proposed a number of responses, including transaction taxes, minimum resting times and order to trade ratios. It has been suggested that some of these measures might penalize "good" HFT while missing the "bad".

Exhibit 1: HFT as a % of European Turnover

Source: Tabb Group, 2007-2012

High Frequency Trading – Here to Stay?

Adapting to the New Normal

These days, High Frequency Trading (HFT) is constantly under the spotlight. Though there is a diversity of opinion as to the benefits (or otherwise) of HFT, a large number of media reports have suggested that the general view of HFT is negative and that restrictions are forthcoming.

Although HFT *is* under significant pressure from regulatory and political scrutiny – HFT firm Eladian Partners closed recently citing "market conditions"[1] – it still represents a significant portion of the market. Tabb Group estimates that HFT represented ~36% of European Turnover in 2012 (Exhibit 1)[2], and while this is slightly down from 2011, HFT is unlikely to disappear anytime soon.
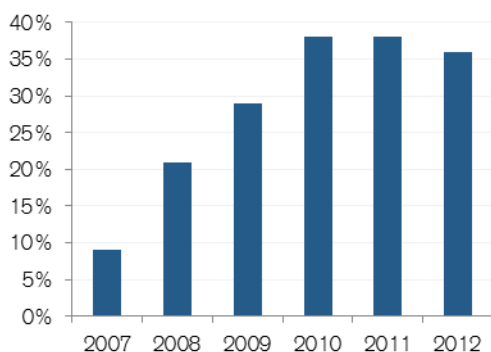
As such, HFT is something that we may simply need to accept as (currently) part of the "new normal", and learn to deal with the various types of HFT appropriately. Akin to email, high frequency trading can be both positive (email is a great tool for productivity) and negative (e.g. the vast amounts of email spam).

Not All High Frequency Trading is the Same

Rather than apply a blanket judgment to all HFT, we group strategies to examine their effects in more detail. On the one end of the spectrum, market making and statistical arbitrage strategies profit by reacting to – and correcting – short term mispricing, thereby improving market quality. In contrast, other strategies such as quote stuffing, latency arbitrage and momentum ignition seek to *create* short term mispricing and subsequently profit from it (a more detailed analysis on "bad" HFT is provided in a separate report High Frequency Trading - Measurement, Detection, and Response).

While all the strategies listed above can be described as "high frequency trading", their effect on the market is markedly different. Separating the "good" HFT from the bad is not an easy task, but it is a vitally important one. A one-size-fits-all prescription for HFT may rein in some bad behaviour, but it risks undoing the benefits of benevolent practices that happen to operate at high speed.

HFT vs. (Agency) Algorithmic Trading

While the terms HFT and Algorithmic Trading are often used interchangeably — and both can be seen as subsets of Automated Trading (i.e. minimal manual intervention) — the distinction between HFT and algorithmic trading is quite clear:

HFT strategies determine (on very short timeframes) whether and when to trade, which security, the size, and whether to buy or sell. They are profit maximising and generally aim to be flat at the end of the day, with full discretion on the trading decision

Agency Algorithmic Trading (such as Credit Suisse AES) aims to optimise execution performance, having been given an explicit instruction to buy or sell a particular security on behalf of a client. The algorithm has *no discretion* on the security, direction or size of the trade; rather, it seeks to minimise trading costs for the end investor within those parameters.

Not All High Frequency Trading is Bad

HFT/Automated Trading often blamed for any disruptions

Knight Capital's recent losses of $461m were correctly attributed[3] to erroneous computerised trading; however, many market disruptions caused by human error have also (at least initially) been rumoured to be caused by computerised trading.

As an illustration, the October 5th sharp fall in India's NIFTY index (see Exhibit 2) was initially rumoured to have been caused by algorithmic trading or HFT. However, the National Stock Exchange later issued a statement specifically highlighting that "non-algo market orders" were behind these price moves.[4]

Exhibit 2: NIFTY index, October 5th, 2012 (UK Time)
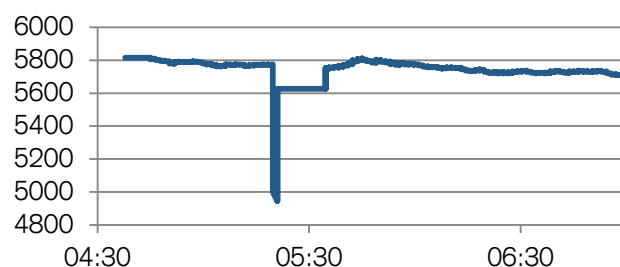
Source: Credit Suisse AES Analysis, Bloomberg

Some strategies can improve liquidity and price efficiency

Not all HFT strategies are created equal, and some – such as market making – can have positive effects and provide additional liquidity. Some commentators have also suggested that HFT firms should be *obligated* to provide liquidity as official market makers, to avoid liquidity disappearing at times of stress.[5]

However, it is worth remembering that during the 1987 Crash, many market makers simply refused to answer their phones [1]. Though today's market makers don't require a phone call to deal, this requirement could be tricky to implement (and may not achieve the desired results).

Index (or ADR) arbitrage strategies keep prices efficient by ensuring that any mispricing across instruments is corrected quickly. High frequency traders sell when securities are overpriced (and buy when they are underpriced) relative to the index, helping to stabilise the market. Similarly, statistical arbitrage models that kick off when prices spike or volume temporarily dries up can help provide additional liquidity and reduce intraday volatility.

## Other studies link HFT to reduced spreads and volatility…

Various academic studies suggest HFT does indeed lead to lower volatility (e.g. [2], [3], [4]), narrower spreads and increased depth (e.g. [2], [5]), and to enhanced price efficiency (e.g. [3]). This improvement in spreads is also demonstrated in Exhibit 3. Within each volatility range, we see spreads generally becoming tighter as HFT has grown since 2007.

### …though tend to not examine specific micro behaviour

The existing studies tend to analyse from a macro perspective and generally do not differentiate between HFT strategies. As such, the positive effects of market making and arbitrage style models may mask the more negative effects of other types of HFT strategies.

We acknowledge that some HFT activity is beneficial, and classing all HFT as sinister is entirely too broad a generalisation. However, it is also important to recognise (and react to) other strategies that are not so benign.
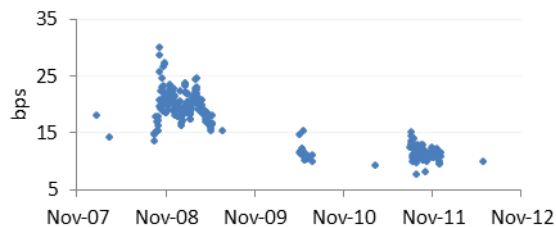
Exhibit 3: STOXX 600 Avg Spreads by Volatility Regime
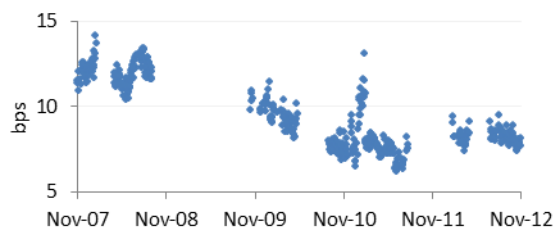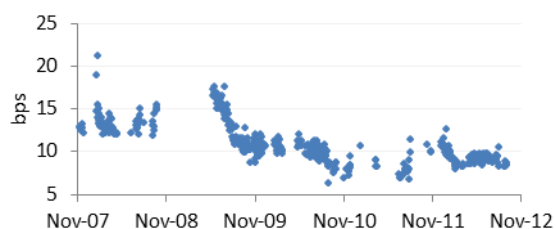
Source: Credit Suisse AES Analysis

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Variants of HFT

There are a number of different types of HFT techniques, and an SEC Concept Release [6] broke them down to four main types of strategies:

<u>Market Making</u>: Like traditional market making, this strategy attempts to make money by providing liquidity on both sides of the book and earning the spread (along with any rebate from posting).

<u>Arbitrage</u>:   Trading when arbitrage opportunities arise (e.g. from mispricing between Indices, ETFs or ADRs and their underlying constituents.)

<u>Structural</u>: These strategies seek to take advantage of any structural 'vulnerabilities' of the market or certain participants, and include latency arbitrage or quote stuffing.

<u>Directional</u>: These strategies attempt to get ahead of – or trigger – a price move, and include order anticipation and momentum ignition.

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But not all HFT is good…

Some strategies seek to distort the playing field

Various parties have raised concerns about negative HFT strategies [7][6]. Examples include:

- **Quote Stuffing**: the HFT trader sends huge numbers of orders and cancels
- **Layering**: multiple, large orders are placed passively with the goal of "pushing" the book away
- **Order Book Fade**: lightning-fast reactions to news and order book pressure lead to disappearing liquidity
- **Momentum ignition**: an HFT trader detects a large order targeting a percentage of volume, and front-runs it.

Market Manipulation is already banned

Of course, market manipulation in any form - whether high or low frequency - is *already* forbidden. Also, momentum ignition (creating "false" volume to force percentage of volume orders to trade) carries significant risk, as the size and timing of other market participants' trades can never be precisely known. Nonetheless, we find evidence of this behaviour on a daily basis.

"Quote stuffing" has become a common occurrence. It involves sending large numbers of orders and cancellations in rapid succession (see Exhibit 4 for an example of quote stuffing on the ask, where many price points last only for microseconds). This behaviour may be designed to slow down market data; try to game the bid or ask to trigger other market participants' reactions in ways can subsequently *be* taken advantage of[7]; or enable other forms of latency arbitrage, which may use other participants' slower connections (or market data) to exploit "stale" prices that the HFT participant knows are no longer accurate.

Timing advantages are nothing new, but the top speed is

While the ability for some participants to react faster than others has always existed - for instance, NYSE floor specialists held significant time and informational advantages well before the onset of electronic trading – the outright speed of HFT *is* a newer phenomenon. And while not all negative strategies above operate on a "high frequency" timescale, they are greatly enhanced by a faster reaction time.

Exhibit 4: Quote Stuffing Example: Capital & Counties Properties PLC, 13th July, 2012

Multiple transient quote updates on the ask, many of which last less than 1 millisecond
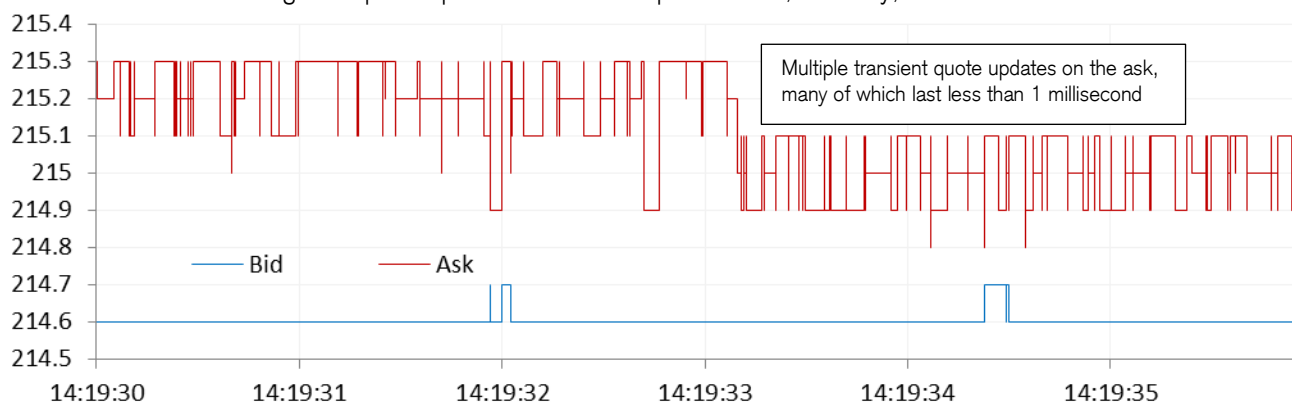
Source: Credit Suisse AES Analysis

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[6] However, this paper does not produce original analysis to quantify its claims - and does not distinguish between agency algorithmic trading and HFT, often using the terms interchangeably.

[7] Quote stuffing may e.g. be used to try to walk someone into the book, create false mid prices that dark pools use as reference prices, or simply create messaging traffic to cause stale pricing and slow market data.

Table 2: Exchanges with Order-to-Trade Ratio Fees

Country	Exchange	Ratio	Fee
Denmark	Nasdaq OMX	250:1	0.01
Finland	Nasdaq OMX	250:1	0.01
Germany	Xetra Frankfurt	Varies by Segment, e.g. DAX 2500:1	Between €0.01 and €0.03
Italy	Milan Stock Exchange	Varies by 'group' e.g. MTA 100:1	Between €0.01 and €0.025
Norway	Oslo Stock Exchange	70:1	NOK 0.05
Sweden	Nasdaq OMX	250:1	0.01

Source: Credit Suisse AES Analysis

NB. Data has been sourced from exchanges and is believed to be reliable, but no guarantee is made of accuracy or completeness, e.g. exchanges may have other rules or exemptions not outlined here.

HFT Market Makers in Stockholm

A recent academic study [4] used Nasdaq OMX data on OMXS30 constituents traded in Stockholm, including the members responsible for each order. This allowed volume from HFT firms (30% in Aug 2011 and 26% in Feb 2012) to be determined.

Using the proportion of time each member was posted at either the bid or ask, the study classified HFTs into market makers and non-market makers, estimating that market makers were 63-72% of HFT volume, as well as 81-86% of limit order traffic.

They also concluded that market making was both good for liquidity and mitigating volatility. They suggested that transactions taxes and order-to-trade ratios would increase costs for market makers, thereby leading to reduced market quality.

The authors also mentioned – as we have – that some non-market making HFT strategies could be malicious, and suggest further research towards singling out those strategies. As we have shown, even passive posting strategies can include quote stuffing, which is detrimental to market quality. So, we agree that a full breakdown of strategies (both taking and posting) would be useful.

Regulators and Politicians Respond
Regulatory change likely to target HFT
With public sentiment generally negative towards HFT, it is not surprising that politicians and regulators have been looking at ways to restrict this activity. While some proposals appear well-crafted to specifically target negative HFT – for example, maximum order-to-trade ratios could greatly reduce quote stuffing – others could run the risk of accidentally penalising the strategies that *improve* market quality.

As mentioned earlier, some negative HFT strategies might be viewed as market manipulation or market abuse. Such HFT techniques could potentially be targeted under the *existing* rules - without having to wait for any new laws or regulations to be discussed, approved and subsequently implemented. Indeed, some have suggested that the EU Market Abuse Directive be updated to "more accurately reflect newly identified practices like quote stuffing" rather than imposing "new, overly burdensome regulation" [8].

Germany and France to introduce new thresholds
On September 26 the German Federal Cabinet approved a draft law (to be submitted to the parliament for further discussion) which includes a requirement that HFT firms be licensed. The law also introduces fines for exceeding a set order-to-trade ratio.[8]

Additionally, the French Financial Transactions Tax (see Europe's Dalliance with FTTs) has an HFT component, which uses the median time between order instructions (e.g. submission to amendment/cancellation) in combination with a cancellation rate threshold. In practice, this is similar to an order-to-trade ratio.[9]

Some Exchanges already have order-to-trade ratio fees
Table 2 shows that some exchanges already charge fees for exceeding an order to trade ratio, including Nasdaq OMX, Borsa Italiana, Oslo Børs and Xetra Frankurt. The ratio thresholds span a wide range, with Xetra's max set at 2500:1 for DAX names, and an average threshold of roughly 1/10th of that figure. The Deutsche Borse has claimed that this charge has been positive for market quality and that the ratio is "not high".[10]

Transactions Taxes Target HFT (at least in rhetoric)
Proponents of transactions taxes often cite the reduction of high frequency trading as one of the desired effects of such a measure, though HFT is not always specifically targeted.[11] For example, the recently enacted French FTT has an explicit HFT provision in addition to its wider 20bp tax on share purchases. However, the HFT component only targets entities located in France, which limits its effect (as many HFT firms trading French names are located outside of the country). Meanwhile, the "tax on shares" is only levied on *net* buys. As HFT strategies generally aim to be flat by the end of the day, it is unlikely that they have been significantly impacted by this provision of the FTT either. For more discussion on other effects of the French FTT see Impact of French Financial Transaction Tax.

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[8] See e.g. http://www.nytimes.com/2012/09/26/business/global/germany-wants-rules-on-superfast-stock-trading.html?_r=1&.
[9] See e.g. http://www.aima.org/objects_store/gide_note_re_french_ftt_-_august_2012.pdf for more details on the HFT component of the French FTT.
[10] See e.g. http://www.thetradenews.com/news/Regions/Europe/Deutsche_B%C3%B6rse_reports_positive_impact_of_message_charges.aspx.
[11] See e.g. http://online.wsj.com/article/SB10000872396390443982904578046532220799200.html

While impact of the French FTT on HFT appears to have been limited, further European FTTs are currently under discussion, including unilateral measures (e.g. Italy[12]) as well as a wider EU FTT. The impact of any new FTTs on HFT (and general trading) could differ significantly from the French example, depending on their scope (i.e. whether these taxes are restricted to shares only or whether derivatives are included), rate of tax and what exemptions may be applicable.

Minimum resting times back on the European agenda

Though the French FTT uses the median resting time to help determine which orders are liable for its HFT provision, it does not dictate an absolute minimum. However, on 26 September the European Parliament Committee (ECON) agreed to update MiFID to require a minimum resting time of 0.5 seconds[13]. This was previously suggested by Marcus Ferber MEP,[14] though a minimum resting time did *not* make it into the German HFT draft law discussed above.

Unintended consequences may penalise real investors

Various market participants (including the Deutsche Borse's Market Policy head[13]) have noted that minimum resting times would have a detrimental effect on liquidity. The UK Foresight Committee [9] predicted "the negative effects will far outweigh the benefits" and labelled it a "terrible idea". Larry Tabb also noted [10] HFTs can take liquidity "just as easily" as providing it, and that

"since market makers and quoting investors are locked into providing liquidity for at least 500 milliseconds, HFTs will be the first to pick off every stale quote. And with a half second quoting mandate, there will be plenty of stale quotes to go around ... once these investors learn this game they will stop posting, and then there will be little incentive for anyone to post quotes".

It should be noted that although the ECON agreed to a minimum resting time, it is not yet clear whether this will actually end up being implemented, or whether the proposal will be changed.

The End of Maker-Taker Pricing?

ECON's revised version of MIFID 2 also proposes banning maker-taker pricing in order to discourage HFT activity,[15] meaning venues would no longer be able to supply rebates for liquidity provision. The removal of such pricing schemes would almost certainly have the effect of reducing posted volumes, as market makers that incorporate these rebates into their models may find that providing liquidity is no longer viable.

The UK Foresight project [11] further noted that the (limited) available evidence suggests maker-taker pricing improves liquidity without negatively affecting spreads. They further state that as its impact is "complex, and related to other issues", focus may be better targeted elsewhere when attempting to "constrain any negative effects".

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[12] See e.g. http://online.wsj.com/article/BT-CO-20121008-708015.htm
[13] See e.g. http://www.reuters.com/article/2012/09/26/cbusiness-us-eu-mifid-idCABRE88P1A920120926?sp=true.
[14] See e.g. http://www.thetradenews.com/newsarticle.aspx?id=9450.
[15] See e.g. http://www.thetradenews.com/news/Regions/Europe/MEPs%E2%80%99_MiFID_text_proposes_maker-taker_ban.aspx

Conclusion

Although high frequency trading is often viewed as entirely negative, we have noted above that not all behaviours attributable to HFT strategies are detrimental to the market. In addition, various studies suggest that HFT has in fact led to an improvement in market quality overall. Nonetheless, it is clear that undesirable behaviour exists; being aware of these scenarios – and adapting to them – is important.

We have presented a number of examples of "bad" HFT – including quote stuffing and order book fade – as well as noting the existence of some of the more benign strategies. In addition, we assessed the variety of current and potential regulatory responses. Some measures – like order-to-trade ratios – are thoughtful and targeted, and most likely improve market quality if formulated correctly. Others, however, seem prone to unintended consequences, especially where their scope is broad.

With the jury still out as to exactly what regulations may be implemented to target HFT (and when that might take place), the influence of this behaviour is likely to form an important part of the trading landscape for the foreseeable future. As such, it is paramount to remain aware and informed about HFT – adapting to its positive (and negative) effects.

References:

[1] Does Algorithmic Trading Improve Liquidity? Hendershott T, Jones C M and Menkveld A J. The Journal of Finance, Volume 66, Issue 1, pages 1–33, February 2011

[2] Low-Latency Trading. Hasbrouck J and Saar G, AFA 2012 Chicago Meetings Paper, Johnson School Research Paper Series No. 35-2010, July 27, 2012
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1695460

[3] High Frequency Trading and Price Discovery. Brogaard J, Hendershott T, Riordan R. Working Paper, July 30th, 2012
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1928510

[4] The Diversity of High Frequency Traders. Hagströmer, B and Norden, L L. Working Paper, September 27, 2012.
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2153272

[5] High Frequency Trading and the New-Market Makers. Menkvel A J. AFA 2012 Paper. February 6, 2012
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1722924

[6] Concept Release on Equity Market Structure. Securities and Exchange Commission, 17 CFR PART 242, Release No. 34-61358; File No. S7-02-10, RIN 3235-AK47.
http://www.sec.gov/rules/concept/2010/34-61358.pdf

[7] High Frequency Trading. Biais B and Woolley P. Working Paper, March 2011.
http://idei.fr/doc/conf/pwri/biais_pwri_0311.pdf

[8] Rise of the Machines. Gronow H, Principal Global Equities White Paper, October 2012.
http://www.principalglobal.com/eu/download.aspx?id=80835

[9] Minimum resting times and transaction-to-order ratios. Farmer J D and Skouras S, UK Government Foresight Project. August 31st, 2012
http://www.bis.gov.uk/assets/foresight/docs/computer-trading/12-1064-eia2-minimum-resting-times-and-transaction-order-ratios

[10] The End Of High Frequency Trading As We Know It? Tabb, L.
http://tabbforum.com/opinions/the-end-of-high-frequency-trading-as-we-know-it

[11] Foresight: The Future of Computer Trading in Financial Markets, Final Project Report. The Government Office for Science, London (2012)
http://www.bis.gov.uk/assets/foresight/docs/computer-trading/12-1086-future-of-computer-trading-in-financial-markets-report.pdf

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