



# High-frequency trading

## Reaching the limits

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The tremendous growth momentum in high-frequency trading (HFT) seems to have reached its limits in recent years. The increasing cost of infrastructure and relentless competition within the industry are probably the first to blame.

In addition, high-frequency trading firms are hardly participating in those dark pools where large block transactions are executed. Both trends are challenging their business model and trading strategies as HFTs have seen their revenues and profits erode. Furthermore, forthcoming tighter prudential regulatory oversight may lead to an overhang of capacity in the HFT industry.

Advancements in trading technologies in recent years allow a very rapid placement of buy and sell orders to implement established trading strategies. Trades can now be executed in micro-seconds, or one hundred thousand times faster than the blink of an eye, which normally takes about 100 to 400 milliseconds. As a result, the use of sophisticated computer programs of extraordinarily high speed for submissions and cancellations of orders to realise small profits – in short, high-frequency trading (HFT) – has become widespread especially in equity markets. HFT's market share has boomed over the last ten years or so and electronic market making has become an integral part of securities trading. In contrast to its early astonishing expansion though, the HFT share in total equity trading has been declining since the financial crisis. An assessment of potential factors that hobble market growth can shed some light on the future growth potential of HFT.

### High-frequency trading in a nutshell

Computing technology has revolutionised the way financial assets are traded. Handling orders without immediate human intervention, where computer algorithms automatically make trading decisions, submit orders and manage these afterwards, has become ingrained in financial markets. Even though algorithmic or automated trading (AT) is not a brand new concept and has already existed for some time now, the speed at which it is conducted has experienced tremendous growth over the past ten years or so. HFT, in turn, is one potential strategy under AT for which trade execution is performed electronically at extraordinarily high speed.



## High-frequency trading

### Characteristics of automated trading 1

#### Common features of AT & HFT

Automated orders and order management

No human intervention

Observe markets in real time

#### Additional features of HFT

Huge number of orders and cancellations

Zero positions at the end of the day

Short holding periods

Low latency times

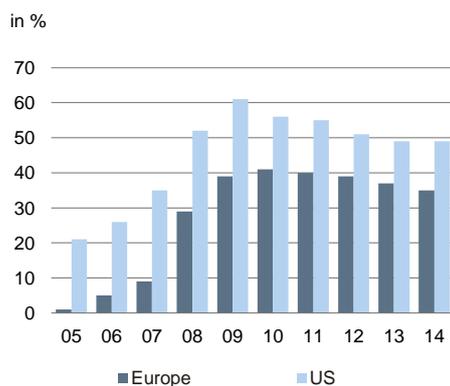
Use of co-location/proximity services

Trade very liquid instruments

Source: Gomber et al (2011), Deutsche Bank Research

Even though HFT is considered a subset of AT, it has important additional features (see Table 1). First and foremost, trade execution times are usually measured in microseconds for HFT<sup>1</sup> and a huge number of orders and order cancellations are required with the arrival of new market information. High-frequency traders have very short holding periods and usually have neutral positions at the end of a trading day. Across the HFT landscape, profit chances are extremely time sensitive and low latency times for trade execution are of central importance to realise at least small profits. In this vein, HFT firms heavily invest in high-speed connections to trading floors and usually place their trading engines close to stock market servers via co-location and proximity services. Ease of trading and the liquidity of the financial product are of particular importance in applying HFT strategies, too. Therefore, high-frequency traders focus only on very liquid assets like blue chip stocks and do not invest in instruments that are traded over-the-counter such as most bonds or derivatives. In constantly providing liquidity, high-frequency traders essentially take on the traditional role of a market maker. More specifically, by using their own trading books to profit from the difference in bid-ask spreads, HFTs act as *electronic* market makers.<sup>2</sup> Unlike primary dealers though, HFTs have no obligation to remain in the market (particularly during turbulent circumstances), and may withdraw at their discretion. In this respect, in the eyes of some observers HFTs act as market makers on their own terms only.

### Share of HFT in total equity trading 2

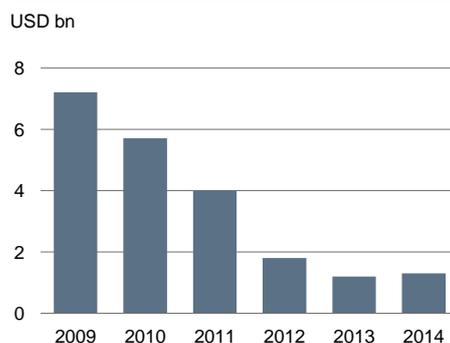


Sources: TABB Group, Deutsche Bank Research

### Recent trends in HFT

Briefly, the evolution of HFT can be divided into two episodes. The pre-crisis period was marked by the rise of HFT on both sides of the Atlantic. In Europe, the share of HFT in total equity trading surged virtually from zero in 2005 to around 40% in 2010. In the US, already 20% of the trades came from HFT in 2005, which peaked at 60% of the market in 2009. However, with the financial crisis, the rise of HFT came to a halt and its market share started to recede. As of 2014, the share of HFT in equity markets had come down to 35% and 50% of the total market in Europe and the US, respectively. A number of factors explain the decreasing HFT market share in total equity trading well: a) a decline in revenues and profits due to the increasing cost of HFT infrastructure and relentless competition within the industry and b) the rise of alternative trading platforms. In addition, forthcoming regulation will act as a further drag on the industry.

### Revenues of HFT firms in the US 3



Sources: TABB Group, Deutsche Bank Research

Overall, HFT firms' revenues in the US have slumped from about USD 7.2 bn in 2009 to USD 1.3 bn in 2014 (see chart 3). This drop may have been partly due to fierce competition which has pushed smaller contenders out of the market and led to trading opportunities disappearing more quickly. Indeed, HFTs execute a huge number of trades with a very small profit per trade. More specifically, HFTs' average profit per share traded is a fraction of a cent and in order to generate meaningful profits, the traders have to execute millions of trades every day. Also relevant in this context is the role of price volatility. In recent years, episodes of heightened volatility have become common in financial markets. For example, between 2010 and 2015 very rare events (a five standard deviation move in asset prices) occurred 2.5 times more often than between 2001 and 2006 in US equity markets. Volatility on financial markets favours HFT in principle. However, the detrimental impact from increased

<sup>1</sup> See Brogaard (2010) for a detailed discussion.

<sup>2</sup> See Chistalla (2011) for a detailed discussion.



competition may have prevailed over this positive effect: in a market with more advanced technology and infrastructure, price disparities across venues will be spotted and balanced ever more quickly. Hence, arbitrage opportunities have probably become scarcer for speed traders in the past few years.

Moreover, increased costs are another drag on the high-speed trading industry's growth. High-frequency traders maximise their revenues via their absolute and relative speed in executing trades. In this vein, co-location services that give access to market information ahead of other market participants, even if only by a few microseconds, are of central importance for speed traders. Spotting the growing demand for proximity, however, major exchanges doubled or tripled their co-location service fees over the 2010-15 period. What is more, the competition on proximity is now an issue beyond exchanges' co-location services. Other infrastructure providers that are specialised in laying cables to transfer data at high speed between electronic trading venues have entered the market as well, in addition to the exchanges that offer quick access to their platforms. HFT firms are, de facto, compelled to use and pay for the most advanced of these infrastructures. For HFTs, speed matters in the relative sense as high-frequency traders have to be at least as fast as (or faster than) their competitors. All in all, the cost of speed trading infrastructure has risen significantly in recent years.

The bottom line is that HFTs have come under pressure on both the revenue as well as the cost front. Unsurprisingly, then, even though a lack of available data prevents a comparison of the number of competing HFT firms over time, data for the US shows that the average profit per share traded has halved, from a tenth of a penny in 2009 to a twentieth of a penny in 2015.<sup>3</sup>

### The role of dark pools

Another challenge that HFT firms face is the advancement of Alternative Trading Systems (ATSs). In short, ATSs are non-exchange trading venues that bring buyers and sellers together outside registered exchanges. Among the most important ATSs are "dark pools" that generally match buyers and sellers anonymously without public information on the best prices. With dark pools, trade volumes and prices are usually publicly reported only upon execution of the deal. Put differently, providing pre-trade anonymity can be seen as the core business of dark pools. The main aim is to have a smaller impact on prices than for trades carried out on exchanges and especially to allow counterparties to trade large amounts without altering the price of the asset.

ATSs actually have been around since about 1960 and are thus not a new invention.<sup>4</sup> However, ATSs in general and dark pools in specific benefited from the adoption of a new regulatory framework ("Regulation of Alternative Trading Systems") by the SEC in 1998. As a result, the number of dark pools has grown significantly in recent years and, by now, there are about 40 dark pools operating in the US and 15 in Europe. The greatest catalyst for the rise of dark pools is institutional investors' growing desire to trade large amounts without altering the price. Even though this is a perpetual necessity of institutional investors, it has become acute with the advance of algorithmic trading and HFT. With the active enrolment of those traders in financial markets, order sizes have diminished and asset prices move more quickly in one direction or the other. Within a dark pool, these moves can be avoided and counterparties can trade securities as a full share block at once.

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<sup>3</sup> Source: Rosenblatt Securities.

<sup>4</sup> See Shorter and Miller (2014) for a detailed discussion.

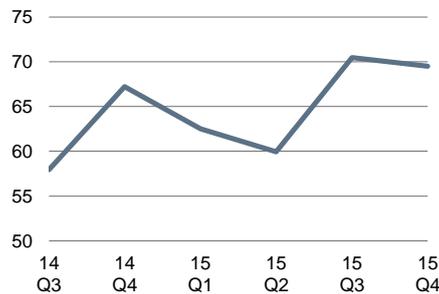


## High-frequency trading

### Trades executed in ATs in the US

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Number of shares traded in bn



Source: FINRA, Deutsche Bank Research

A lack of available data prevents a detailed analysis of dark pool trading, but trading in ATs in general serves as a good proxy to show general trends. In recent years, ATs have attracted significant trading volumes and an increasing share of trades are now executed off the exchanges. The number of shares traded on these venues in the US jumped from 57 bn in Q3 2014 to 70 bn in Q4 2015 (see chart 4). Other estimates point out that around 40% of US trades took place off the exchanges in 2014, up from 16% in 2008. That said, HFTs are not per se locked out of these venues and in principle have access to ATs. However, they are mostly active on so-called streaming liquidity pools (see box 5), i.e. ATs that focus on matching small trades, while they are less engaged in block-oriented dark pools where certain minimum requirements regarding order size exist. In other words, the growing role of dark pool trading limits the ability of high-frequency traders to apply their strategies to very large block trades. This probably puts significant further pressure on the revenues of HFT firms.

### Types of dark pools

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In terms of the size of trades executed, dark pools can be grouped into two types.

First, there are block-oriented dark pools that specialise in matching block trades. These are particularly suitable for institutional investors such as asset managers and pension funds. An order is considered a block trade if it consists of a very large number of shares or a high market value, i.e. the hurdle could be a minimum of 10,000 shares or a total market value of USD 200,000. It is even virtually compulsory to trade these orders in dark pools, as they might go beyond the entire supply and demand of a typical business day on an ordinary exchange. That said, for very large trades it might sometimes be difficult to find a match even in a block-oriented dark pool due to the order size.

Second, another group of dark pools, so-called streaming liquidity pools, deal with retail size orders and allow participants to trade small quantities. On these venues, there is no minimum order size required for access. As a result and unlike block-oriented pools, HFTs are actively involved in these venues. The enrolment of HFTs results in favourable liquidity characteristics and improves the likelihood of a timely match for trading counterparties.

Source: Vaananen (2014), Deutsche Bank Research

## Stronger regulation is on the horizon

Apart from the market dynamics themselves, the forthcoming tougher oversight and regulation will drastically shape the future of HFT as well. After the “Flash Crash” in May 2010, when major indices dropped around 10% intraday, policy makers have been taking a deliberate course on HFT both in the US and in Europe. Indeed, in the eyes of some observers, algorithms do not follow economic fundamentals and merely chase mechanical patterns which may harm the functioning of financial markets significantly. To mitigate these stability concerns, the Markets in Financial Instruments Directive (MiFID) 2 introduces major changes to how financial instruments are traded and distributed in Europe. It imposes stricter requirements on trading venues and market participants that engage in AT or HFT. Among these are speed bumps that artificially slow down the trade order speeds, order-to-trade ratios that prevent overly rapid and frequent submitting and cancelling of orders as well as systems and risk controls to ensure resilience of venues. Also included in MiFID 2 are direct market access limits and algorithm disclosure requirements for HFT firms. MiFID 2 rules are expected to come into force in January 2017. In the US, meanwhile, authorities have been somewhat slower in addressing HFT regulation. The SEC aims to i) introduce an anti-disruptive trading rule, ii) improve risk management practices for trading algorithms and iii) enforce stricter use of its core tool of registration and oversight. CFTC & SEC rule making for HFT are expected to be finalised in 2016.

## Closing remarks

As the HFT technology matures, the costs of speed trading have increased and unbroken competition for speed has reached its limits. As a result, HFT firms are seeing their revenues and profits erode. Restricted access to dark pools’ block trades has been challenging HFT firms’ trading strategies further. On top of this, forthcoming stricter prudential regulatory oversight may result in an overhang of capacity in the HFT industry. All in all, the glory days of HFT seem to be over and HFT will probably offer reduced opportunities in established equity markets in the future.

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