

# High Frequency Trading

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## **Contribution declaration**

This report has been written and edited jointly by both authors

## **Purpose**

The purpose of this reading project is to give the reader an overview of the most important aspects of high frequency trading and the underlying strategies which are used. We will also look into ethics in the financial market and in particular regarding high frequency trading. This project also makes an attempt to discuss high frequency trading, what kind of risks are involved and the trading effect on the market.

## **Introduction and evolution of High Frequency Trading**

The general strategy behind high frequency trading, abbreviated HFT, has been around since the 1930's. In the 1930's some traders used high-speed telegraphs enabling fast and low latency access to the stock exchange. The traders who used the high-speed telegraphs suddenly acquired an advantage in speed that made it possible to act faster than the rest when new information arose (Milnor, 1931).

High frequency trading is considered as a subset to Algorithmic Trading. Algorithmic Trading, AT for short, is dependent on computer power to execute trades. Most AT algorithms are implementing sophisticated and advanced mathematical formulas (Chen, 2019).

AT is very common on the market today, but that has not always been the case. For instance, in 2003 AT accounted for 15 % of the market volume, and nine years later in 2012 it accounted for 85 % of the market volume (Glantz, 2013). One particular important reason for the increase in AT was due to regulations in Europe and the United States which benefited AT traders in general<sup>1</sup>.

Due to advancements in technology alongside the digitalization of trades by Nasdaq in 1983, HFT has become ever faster. HFT relies heavily on speed and that is enabled by superb computer power. Both AT and HFT are similar in because they are both dependent on computer power. The important difference between AT and HFT is that HFT executes trades in an extremely short time interval, which is not by definition the case for AT. Another difference between the two is the number of shares traded in a given time period (Chen, 2019).

## **Strategies**

### **Prevalent Strategies**

There are some different strategies used in HFT and they are constantly evolving. One of the more common strategies used is to utilize arbitrage situations when they appear on the market. These arbitrages are of different kinds, such as event arbitrages, statistical arbitrages and index arbitrages. While arbitrage situations on the market are rare in general, the short amount of time that HFT firms execute the trade makes the arbitrages more common. The key to success in these arbitrage situations is to execute them fast, i.e. produce the fastest algorithm for executing deals, supported by immense computer power.

Another interesting strategy is called Filter trading. The idea behind Filter trading is to monitor multiple news sources and to use an algorithm which takes in data from these news

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<sup>1</sup> NMS-regulation in the US, put in effect 2005 and the MiFID-regulation in Europe, put in effect 2007.

sources. This information is then analyzed and afterwards a decision is made whether or not to trade a given security. This approach may seem unconventional, but it is important to remember that it is an algorithm and not a human decoding the information (Chen, 2019).

### **Market-manipulative strategies**

A reason why some view HFT in a bad light, is because some of the strategies that have been used by HFT traders are considered illegal. These strategies fall under market manipulation and in the past companies have been charged for using these.

Different strategies are used to manipulate the market. To begin with, one strategy is called quote-stuffing. The idea behind quote-stuffing is to "flood the market", which is achieved by placing a huge amount of orders on a given stock. The aftermath is confusion on the market and as a direct result the market gets slower. The HFT trader then utilizes his own created opportunity, which in fact is an arbitrage situation caused from him deliberately flooding the market. This temporary opportunity only last for a very short time span, but because of the inherent speed of HFT the trader manages to seize his own created opportunity.

Another strategy in the same category is called spoofing and layering. The aim with this strategy is to create a false optimism in an asset that an HFT trader is looking to sell. The false optimism is created by a large number of bids by the same trader on the asset. The bids are cancelled in milliseconds before the order has been filled. The, however false, increase in demand is pushing the price higher. The same HFT trader is making a profit, which is the same as the difference between the new and original price. This strategy is regarded as illegal and there have been cases where companies have been charged for applying this strategy (Comstock, 2013).

### **Views on high frequency trading**

Regarding HFT firms and/or traders' effect on the financial market the experts are not in agreement. The question you might ask yourself is if HFT is good or bad. Since this question is not black and white and there is no obvious answer, it is imperative to examine on which grounds HFT might be good or might be bad, in respect to the financial market.

A well-known opponent of HFT is Michael Spence, Nobel Prize winner in economics and professor at Stanford University. Spence argues that HFT should be banned, since it increases the volatility and increases the risk on the financial market. Spence's proposal is quite extreme, because he does not propose regulatory measures or other similar constraints. In practice, banning HFT would be difficult since there are financial institutions earning large profits due to it (Phillips, 2011).

Additionally, HFT is often attacked on the basis that it is unfair to the smaller players since they lack the resources to compete on equal grounds against HFT firms (Chen, 2019). There are also claims that HFT can cause market crashes. We will discuss this topic later in the report.

On the other hand, some experts are more positive about it. Jonathan A. Brogaard writes in the report "High Frequency Trading and its Impact on Market Quality" about the impacts that HFT is having on the market quality. Brogaard claim that HFT plays an important role in the market since it is vital for the functions of price discovery and price efficiency. The author

further claims that there is no empirical evidence that HFT increases volatility on the market. In fact, he argues that HFT tends to decrease the volatility. (Brogaard, 2010).

Douglas Cumming, professor at Florida Atlantic University, writes in the article “High-Frequency Trading and End-of-Day Price Dislocation” that it is more likely than not, that HFT has done more good than harm in the marketplace. Furthermore, Cumming makes the case that HFT increases the liquidity on the market, narrows the bid-offer spread, lowers the volatility and in general makes trading cheaper for other participants (Cumming et.al, 2013).

### **The Flash Crash 2010**

An example that displays the ambivalence among the HFT scientists is the Flash Crash of 2010. A flash crash is a specific happening in the market that is characterized by the movement of the number of shares being traded and the prices of the stocks in the market. More specifically, the common pattern is that a considerable number of shares are being withdrawn, which leads to that the price of different stocks, and the market index in particular, declines in a very dramatic way. On the sixth of May 2010 the biggest flash crash in recent time occurred and it is simply referred to as the Flash Crash. During the crash the Dow Jones Industrial Average Index fell 1000 points in 10 minutes, equaling to a drop of 9%. However, the market rebounded rapidly and at the end of the day 70% of the loss was regained (Kenton, 2018).

Critics of HFT claims that it was the cause of the crash. They argue that the Flash Crash is a perfect example of how HFT causes volatility and uncertainty in the money market. A government investigation blamed HFT for the Flash Crash. The fact that the investigation was made by a branch of the government made the critique more valid and more likely influenced people's general views of HFT (Chen, 2019).

To the contrary, some experts have a more positive view of HFT and the effects it has on the market. These experts believe that the reason the market rebounded in such a rapid way was a consequence of HFT. Michael Corkery writes in the article “Jim Simons on Flash Crash: High Frequency Traders Saved the Day” that HFT literally saved the day. After the crash many traders pulled back and stopped trading. The main reason why the market rebounded, was because HFT traders did not pull out of the market, and continued to trade (Corkery, 2010).

Another take on the subject is found in Kirilenko's (et.al) paper “The Flash Crash: Impact of high frequency trading on an electronic market”. The authors state that while HFT was not the cause of the crash, the strategies used by the HFT firms increased the drop of the market index (Kirilenko, 2011).

To conclude, how the Flash Crash was created, is still debated to this day. Interestingly, the fact that experts, both for and against HFT, uses the Flash Crash as an argument shows that HFT effects on the financial market is a very complex subject.

### **Ethics and Regulations**

Ethics and regulations in general and in the financial market in particular is a very interesting subject. The difference between right and wrong, legal and illegal, can be blurry. For HFT this is especially true because the algorithms used are secret and unknown. The reason why companies keep their algorithms hidden is because they are an important revenue stream.

In the paper “The Mysterious Ethics of High Frequency Trading”, written by R. Cooper, M. Davis, and B. van Vliet, four types of regulatory measures in the financial market are presented. The first measure concern internal regulation, while the other three deals with types of external regulation. The first measure is self-regulation. The other regulatory measures are regulation by venue, such as the NYSE, by the industry, for example the Financial Industry Regulatory Authority and by the government. Establishing a set of internal ethics is a way to limit and control one’s behavior and actions and can therefore be viewed as a type of self-regulation, for a group or an individual (Cooper et.al, 2015).

Cooper and his colleagues stress the importance of establishing prudent high frequency trading strategies. They make the case that algorithmic trading strategies should satisfy three criteria, which are a part of a framework created by Cooper et.al. For a trading strategy to be considered prudent it must satisfy these three criteria. First, the strategy is to be monitored in real-time as to ensure it operates within the trading strategy. Furthermore, the strategies inherent risk must be reasonable and at the same time generate a satisfactory amount of revenue over a period of time. The authors argue that if these criteria are met, the trading strategy is not probable to hurt the firm, other market players, or the trader. One of the arguments against high frequency trading is that it poses as a threat to market stability. Cooper and his colleagues make the case that if the trading strategy is prudent, does not hinder price discovery and does not bypass transparent price discovery, for example by using dark pools or hidden orders, could promote a fairer and efficient market (Cooper et.al, 2015).

Cooper et.al. advocate that while some HFT strategies ought to be regulated, the primary objective should be to promote an efficient market. The authors express a fear that too much regulation can hinder an evolutionary ecosystem. They believe that unnecessary regulation could lead to a skewed marketplace, in which the regulations dampen competition (Cooper et.al, 2015).

All in all, regarding the ethics surrounding high frequency trading as well as the automated financial market it is difficult to draw a line in the sand and say what is legal and illegal, fair and unfair. Since the area is somewhat of a grey zone minimal regulation as opposed to heavy regulation, would be preferable if considering market efficiency. If any regulatory measures were to be taken, they should therefore be judged and evaluated based on their effect on the market.

## **Discussion**

HFT is a complex topic. Since companies keep their algorithms from the public, we are not really sure what HFT algorithms do and how they operate. Also, because they are not accessible, we do not know whether the algorithms are legal or not. This is the reason why regulatory measures addressing the lack of transparency within HFT would be a good thing. Although, in practice this is close to impossible, because the companies obviously do not want to share their algorithms, which are their most important asset. If the algorithms become public knowledge, the company loses their point of advantage.

Concerning HFT strategies it is important to distinguish between legal and illegal strategies. One possible reason for the bad reputation of HFT is that the illegal strategies used by some companies overshadows the positive aspects of legal HFT strategies. When addressing the

risk that HFT has on the financial market it is important to be specific. Often the inherent risks of HFT are also rooted in the existing market structure.

Ethics and regulation are both interesting because an obvious fix does not exist. However, as presented earlier in this paper a way to tackle this is by internal and external regulation. Establishing prudent strategies is a favorable approach because it does not require external regulation. A good reason to avoid external regulation is that it can lead to a distorted market and negatively affect market efficiency.

There are different views regarding HFT impacts on the market. Some experts argue that HFT overall impact on the market is positive, due to faster price discovery, less volatility and because it narrows the bid-offer spread. On the other hand, other experts are of the opinion that HFT increases volatility on the market and that HFT can cause crashes on the market, such as the Flash Crash. The research of HFT impact on the market is inconclusive. Hence it is difficult to come to a conclusion and more research is needed on the subject.

## Reading guide

Here you can find links to interesting research papers about high frequency trading. Below you can also some interesting news articles on the subject, along with some videos.

### Research papers

- The Mysterious Ethics of High Frequency Trading, Cooper et. al. 2013  
<http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=0&sid=1cc4a45d-3d92-4b55-9ddf-2b252df79576%40sessionmgr4010>
- The Flash Crash: The Impact of High Frequency Trading on an Electronic Market, Kirilenko et. al. 2011  
<http://ssrn.com/abstract=1686004>

### News articles

- This news article gives an insight into the dark side of high frequency trading and  
<https://www.theguardian.com/business/2014/jun/07/inside-murky-world-high-frequency-trading>
- This article talks about the more positive aspects of HFT and what role it played in the flash crash of 2010  
[https://blogs.wsj.com/deals/2010/09/13/jim-simons-on-flash-crash-high-frequency-traders-saved-the-day/?goback=.gde\\_86999\\_member\\_29971040](https://blogs.wsj.com/deals/2010/09/13/jim-simons-on-flash-crash-high-frequency-traders-saved-the-day/?goback=.gde_86999_member_29971040)

### Videos

- This video is a Ted Talk about high frequency trading and the new algorithmic ecosystem  
<https://www.youtube.com/watch?v=V43a-KxLFcg>
- Interview with the CEO of a high frequency trading firm. Very insightful video since it brings up the trader's perspective.  
<https://www.youtube.com/watch?v=WyPPaiZEYO4>

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6. Cumming, et.al, 2013, High Frequency Trading and End-of-Day Price dislocation, Taken from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2145565](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2145565)

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8. Kenton, Will, Investopedia (2018). Flash Crash. May 9, 2019, <https://www.investopedia.com/terms/f/flash-crash.asp>

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