In the era of high frequency trading, has the principle of limited liability outlived its usefulness?

Table of contents

Section	Page
1.0 Executive Summary	3
2.0 Introduction	4
3.0 Analysis and discussion	6
3.1 Types of high-frequency traders	6
3.2 The need for speed	6
3.3 Flash crash 2010	9
3.4 What are the benefits of HFT for markets?	11
3.5 What are the drawbacks of HFT for markets?	11
3.6 HFT and limited liability	12
4.0 Conclusion	14
5.0 References and bibliography	15

1.0 Executive Summary

The aim of this report is to establish whether or not the principle of limited liability is still useful in light of the now established electronic trading method of high-frequency trading. It looks at how high-frequency trading generally works, along with how it benefits markets, as well as the problems that it has been known to cause, including a focus on the Flash Crash of 2010. It takes into account opinions from those who presently work or formerly worked within high-frequency trading as well as those who have analysed how it works. The report concludes that the unpredictable nature of HFT and the slow response of regulators mean that the protection offered by limited liability for shareholders is still required; however, it leads to another question, which is, does protection offered to shareholders by limited liability alone go far enough?

2.0 Introduction

Traditionally, investors use stock markets to grow their money by buying shares in companies that they think will do well in the longer-term. Journalist Andrew Smith (2014) sums up how high-frequency trading (HFT) has changed this model:

> "The stock market had been designed as a means of allowing capital to flow where it could be most useful, allowing individuals with excess money to invest in the energy and ideas of others. But HFT was nothing to do with value assessment or creation: the machines' sole aim was to use speed to game the market."

The Wall Street Crash of 1987 saw a 22.61% fall in the value of the US stock market. In the aftermath of the crash, there was a conscious move towards greater use of technology in the US stock market (Lewis, 2014). Agarwal (2012) explains that the traditional open outcry method of trading has been in demise for some time, with only one or two exchanges globally still utilising this process. Automated systems have taken its place. The last thirty years has seen global regulators promoting greater transparency among stock exchanges in their markets. This has coincided with the development and use of sophisticated and extremely fast computer technology, giving birth to HFT. HFT is defined by ft.com (2012) as:

> "High-volume trading is used by proprietary traders and a new breed of electronic trading outfits (typically privately held). It relies on synthesising information faster than other traders using sophisticated trading algorithms and powerful computers, often co-located near the electronic matching systems within securities exchanges."

HFT is becoming increasingly more prevalent across stock exchanges globally, accounting for nearly 60% of equity trade volumes in the US and nearly 40% in Europe respectively in 2010, as can be seen in figure 1below;

Figure 1 – HFT as a percentage of turnover of equity trades in the US and Europe (2005-2010)

Source: ft.com

HFT offers some advantages to markets, however, there are those sceptical about the motives and methods used by high frequency traders, amplified by events such as the 2010 Flash Crash.

Using secondary research, taken from online articles, reports and journals, this report aims to investigate how high-frequency trading works. It will look at the benefits and drawbacks of this method of trading and how investors and company shareholders are impacted upon, to establish whether limited liability is in fact still useful.

This project title was selected as it is a current topic, with some high profile recent events involving HFT appearing in the news. HFT was not specifically covered in the CISI Diploma syllabus and seemed like a challenging and intriguing topic to investigate.

3.0 Analysis and discussion

3.1 Types of high-frequency traders

Agarwal (2012) identifies three main types of high-frequency traders. The first type is independent, proprietary firms. These firms use private money and remain less open about how they carry their business. These firms often act as market-makers, providing liquidity to stock markets. They place buy and sell orders for shares on the market right through the day. Market-makers sit in between buyers and sellers and make money via the bid/ask spread. Those trading on an exchange are likely to buy and sell shares from these firms at some point.

The second type of high-frequency trading firm is a broker-dealer proprietary desk. This is where traditional broker-dealer firms such as investment banks (the likes of Goldman Sachs) have separate HFT trading desks from those who deal with client business.

The final type of firm engaging in HFT is a hedge fund. They use money from outside investors to make money by taking advantage of pricing inefficiencies between securities, identified via complex mathematical modelling techniques, all made possible via HFT.

3.2 The need for speed

The clue to how high-frequency traders differentiate themselves from traditional traders lies in the name itself. Michael Lewis' book, 'Flashboys' (2014) discusses in some length about the desire of high-frequency traders to possess the fastest connection speeds to stock exchanges. As the book explains, there is an obsession with 'latency'. Latency refers to the time between the moment a signal is sent by a trader and when it is received by a stock exchange. The latency of a stock market system is determined by four factors:

a) **Boxes.** These are the machines that the electronic signals are passed through. This includes the servers, the switches and signal amps
b) **The logic**. This is the software. It is the coding which provides instructions to the boxes to operate.
c) **The lines**. The glass fiber-optic cables that carry the electronic signals from one box to another.
d) **Distance the signal needs to travel** between the trader and the exchange.

As Lewis sees it, the biggest enemy to quicker latency times is the distance the signal has to travel. The further the trader is from the exchange, the longer it takes

for signals and messages to reach the exchange. Lewis interviewed Ronan Ryan, an electronic trading expert who was initially providing consultancy services to banks, HFT firms and proprietary trading firms on reducing latency times. Ronan was initially unaware of the reasons why these organisations were so interested in reducing latency times, however, over time it became apparent that they were paying very large sums of money to gain a competitive edge over each other and other investors in the markets.

Initial conversations between Ronan and high-frequency traders were concerned with laying the relevant cables (the lines) to reduce the distances that signals had to travel between them and the exchanges. As Lewis explains (2014, p39):

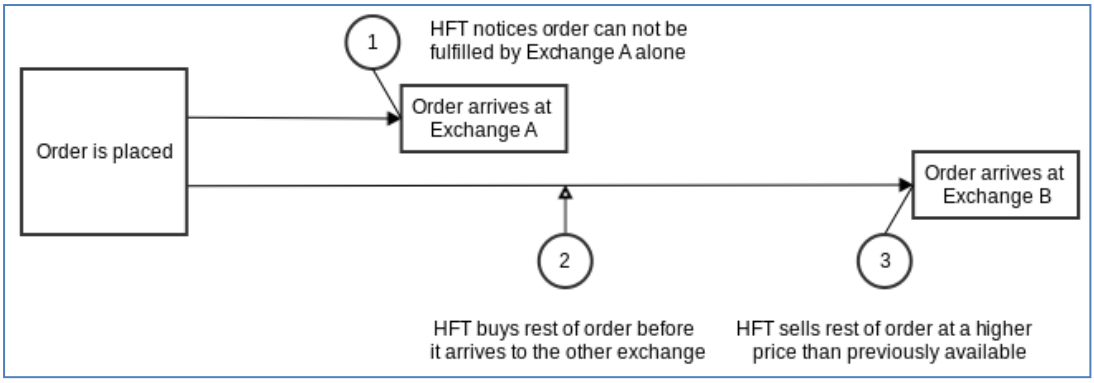
> "The whole purpose of the line was to create inside the public markets, a private space, accessible only to those willing to pay the tens of millions of dollars in entry fees."

It got to a point where the traders wanted their boxes inside the exchange, to be within feet of the exchange's main servers. Once the firms had established that they couldn't reduce the distances any further, conversations began about installing more efficient data switches and fiber-optic cabling. Ronan explained to Lewis that microseconds became critical to these organisations.

How do super-fast connections benefit high-frequency traders?

Lewis (2014) also interviewed Brad Katsuyama. Brad worked for many years at the Royal Bank of Canada (RBC), where he was the Global Head of Electronic Sales and Trading. Brad had been experiencing problems when placing large orders for shares, which were unable to be fulfilled by one stock exchange. He found that he could purchase a portion of the order from one exchange without any problems but when it came to the remainder of the order, the price of the stock on the other exchanges had gone up in the blink of an eye. Through the use of super-high speed connections, high-frequency traders were able to see that the large order would not be fulfilled by one exchange. Consequently, they would then buy the remainder of the order at the original price from the other exchanges, before selling them at a higher price to the frustrated trader who was originally trying to buy them. This became known as 'front-running'. High-frequency traders were therefore able to make money very quickly by viewing the market and anticipating demand for stocks across a number of different exchanges via high speed connections. See figure 2 below, summarising how high-frequency traders pre-empt the market;

Figure 2 – The process by which high-frequency traders can anticipate the market with large orders



Source: Wikipedia

The use of algorithms and ultra fast connections meant than they could stay one step ahead of those who did not have access to the technology. Katsuyama, traders and fund managers at different firms found themselves constantly chasing prices. The additional costs which were being incurred by these unsuspecting firms were causing problems and nobody knew what was causing it or how to solve it.

After speaking to a number of traders, Brad soon realised that he was being 'front-run' in that another trader was in effect noticing his demand for stock on one exchange and buying it in others in anticipation of selling it to him at higher prices. He suspected that high-frequency traders were responsible. With permission from his bosses, Brad assembled a team at RBC to experiment and test the markets. Katsuyama hired Ronan Ryan, who as previously mentioned had been assisting HFT firms in getting the infrastructure set-up to trade in this way.

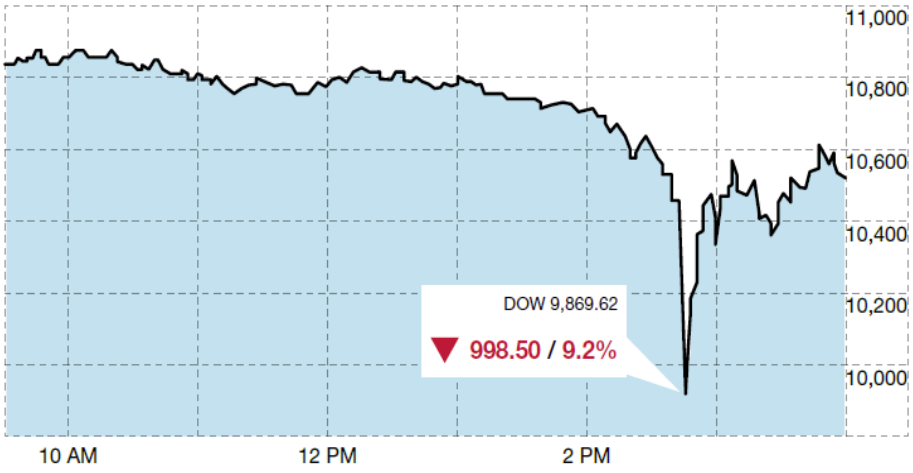
Ryan explained to Katsuyama that he had seen HFT firms creating latency tables. They were tables of data which detailed the times it took for each brokerage house to communicate with exchanges. These were highly valuable to high-frequency traders as they could identify the time it took orders to travel from one exchange to another. This enabled them to quickly identify the exact broker carrying out a stock market order. Consequently, high-frequency traders were able to find patterns in each broker's behaviours and pre-empt their actions, allowing them to act first and capitalise as a result. Lewis (2014) summed the problem up when he said;

> "The US stock market was now a class system, rooted in speed, of the haves and the have-nots. The haves paid for the nanosecond; the have-nots had no idea that a nanosecond had value. The haves enjoyed a perfect view of the market; the have-nots never saw the market at all."

3.3 Flash crash 2010

It was the Flash Crash on 6 May, 2010 which brought HFT into the limelight. The subsequent SEC report into the incident laid the blame at an obscure Kansas City mutual fund that at 2.40pm on that day, placed an order on the Chicago Mercantile Exchange to sell 75,000 E-mini futures contracts (stock market futures contracts). The Chicago Mercantile Exchange is seen as an indicator of market sentiment. This very large sell order seemed to be executed by an automated program and resulted in panic in US markets as others began 'following the herd' and also started to offload equities. At around 2.42pm, prices started falling. By 2.45pm, the Dow Jones Industrial Average (DIJA) had fallen 998.50 points (9.2%), as highlighted in figure 3 below. Then, as quickly as prices started to fall, they began to recover with the market closing 348 points down (3.2%).

Figure 3 – Dow Jones Industrial Average, 6th May 2010



Source: CNN Money

Smith (2014) interviewed Eric Hunsader, creator of the 'NXCore' program which collects, stores and relays stock market data to clients. In the two years before the 2010 Flash Crash, he recalls that he had seen increasing numbers of 'messages' on the system where prices of orders or the size of quotes were being changed, despite the numbers of trades remaining constant. At 2.30pm on 6th May 2010, Hunsader noticed the highest message rate he had ever seen on the New York Stock Exchange system.

Following the Flash Crash, Hunsader went back to the data taken by NXCore at the time of the event. He noticed that there was a delay on price information going to the exchange's securities information processor (relied upon by participants for live market data, which is a paid for service). When pundits and the public thought that the DJIA was in freefall, it was actually rallying. This would obviously have had an impact on the decisions made by buyers and sellers as they reacted to information

which was not in real-time. Hunsader said that it was as if the exchange system had "broken down due to information overload". He noted that there was a 24-second delay on information for General Electric shares, with other stocks seeing a 36-second delay. Some stocks were also trading at very low prices, whilst others were trading at a very high price. Shares in Accenture were trading for a dollar while Hewlett Packard was trading for more than $100K.

Hunsader saw patterns in the data which highlighted that machines were placing and cancelling the same order 10,000 times in a second, almost as if it was designed to manipulate the system and avoid detection. Questions started to get raised around whether it was possible that the Flash Crash had been caused on purpose by high-frequency traders 'stuffing' the New York Stock Exchange with messages so that the system would slow down and create price discrepancies. As a consequence, much faster machines would be able to take advantage of those discrepancies to make money.

The high cancellation rates of orders Hunsader alludes to could potentially be explained by the fact that most high-frequency trading firms act as market-makers on an exchange. In an article written by Levine (2015), he explains that market-makers naturally have high cancellation rates of buy and sell orders as they have to establish the prices at which to buy and sell specific shares across a multitude of exchanges. This can involve cancelling buy and sell orders regularly to balance supply and demand in the market. Levine quite easily demonstrates that a market-maker can achieve a 95.5% order cancellation rate just through undertaking normal market-making duties across multiple exchanges. It is therefore quite feasible for market-makers to cancel very large amounts of orders in a very short space of time. Levine does however state that some of these orders may well be placed to create an illusion of demand, or 'spoofing' as it is known.

Lewis (2014) confirms Hunsader's suspicions that 'stuffing' and 'spoofing' were taking place. He explains that when experimenting with the BATS exchange, Brad Katsuyama found that HFT firms would place small bids and offers, typically for 100 shares, for every listed stock. They were fishing to see where the demand was and would race ahead to the other exchanges to buy and sell accordingly. The high-frequency traders were not interested in the small orders they placed to buy and sell. They would cancel the majority of these orders to pursue the bigger ones identified via their probing of the market.

3.4 What are the benefits of HFT for markets?

Although high-frequency trading has been subject to a large amount of criticism, especially after the fallout from the 2010 Flash Crash, there are several benefits that it offers to the market. Smith (2014) interviewed David Lawer, a former high-frequency trader, who rationalised the role of HFT as; "Providing the lubricant which allows the wheels of capitalism to turn".

The main benefit frequently highlighted is that of increasing liquidity within the market. In a market-maker capacity, high-frequency traders provide continuous buy and sell offers for stocks and shares, which means there is a greater flow of orders within the market. This makes it easier and quicker for retail and institutional investors to buy and sell shares.

Secondly, HFT reduces transaction costs for retail and institutional investors. HFT has helped to make bid/ask spreads narrower. HFT has resulted in traders providing the most competitive bid-ask price, which has led to cheaper transaction costs.

Thirdly, it is has been suggested that HFT has improved market efficiency. The speed at which HFT works means that prices are updated more frequently with increased levels of accuracy achievable.

3.5 What are the drawbacks of HFT for markets?

Firstly, institutional investors such as pension funds and collective investment schemes have highlighted that HFT hinders rather than benefits them. When Smith (2014) interviewed Eric Hunsader, he commented that;

> "You could see the way large pension funds and mutual funds were lured into traps – algorithms probed them for signs that they were about to buy or sell and then used superior speed to get them to sell higher or lower."

If high-frequency traders are front-running institutional investors, as also suggested by Brad Katsuyama (Lewis, 2014), it would lead to higher costs for them. This would have a knock-on effect for those investing indirectly into a fund.

The second main drawback is that of increased volatility. The Flash Crash of 2010 highlighted that HFT can cause market instability. As a contrasting view, a UK Government Office for science report (2012) stated that there was no direct evidence that HTF increases market volatility. Indeed the SEC report following the event in May 2010 did not initially place the blame at the feet of HFT. The argument is that as HFT represents a high percentage of overall trading on markets, price fluctuations caused by HFT can lead to volatility. A higher risk of unstable markets as a result of HFT would not be music to the ears of any investor.

Finally, the high-tech equipment at the disposal of high-frequency traders is not possessed by smaller investors as the cost to acquire them is far too high. This puts smaller investors at a disadvantage.

3.6 HFT and limited liability

As the CISI workbook (Seaward, 2013) explains, limited liability is mainly achieved through incorporating a company limited by shares. By doing this, a company is created which has a separate legal identity from its shareholders. This means that a company has similar rights to a legal person. One of the most important rights a company has is that it cannot be dissolved or wound up at will. There are certain requirements that have to be met, which protects the company from over-zealous shareholders. Similarly, limited liability is put in place to protect shareholders. It ensures that shareholders are only liable for the amount invested in the business should a company be wound up. There are however occasions when limited liability for shareholders does not apply. Limited liability may not apply if a company is used to launder money or to avoid its legal obligations such as paying tax.

From the research and points explored in this report up to now, HFT has been seen to exacerbate market risk for shareholders, as demonstrated during The Flash Crash of 2010. Although this may have had negative impacts on the value of investments held by shareholders in some companies, the markets recovered and investments are likely to have regained some or all of their value since the mini-crash.

In terms of limited liability, the question is what is the propensity for HFT to cause a stock market crash which could cause wider negative implications for the economy as a whole? Does HFT increase systemic risk?

Seaward (2013) explains that dubious practices only really come under scrutiny after a major incident occurs, such as a stock market crash. In fact, it has been said that in the US, the Regulation National Market System (Reg. NMS) passed by the SEC in 2005, which promoted transparency and competition between markets, enabled high-frequency traders in using practices such as ‘front-running’.

Ezra Rapaport, a former high-frequency trader and computer science graduate from Harvard, was interviewed by Smith (2014) and suggested that HFT could be extremely damaging to markets, “You’ve got computers dealing with real money, placing orders and bonds. The capacity to bankrupt the entire operation – the capacity for loss – is immense.”

Certainly, since the 2010 Flash Crash and the implosion of high-profile market maker, Knight Capital, in 2012 as a result of electronic trading, there has been increasing use of regulations and exchange reforms (mainly the use of circuit-breakers when share prices fall by a certain amount) to attempt to control and limit the potential negative impacts of HFT on financial markets. However, many believe that the changes do not go far enough. In an interview with the FT (2016), Mark Gorton, founder and head of HFT firm, Tower Research Capital, suggested that exchange –level risk controls were “limited at best”. He went on to say that not addressing the current frailties could be disastrous;

> "We're creeping in the right direction, but unless we proactively address these issues, sometime in the next several decades we are going to experience a catastrophe due to runaway computerised trading,"

A UK Government Office for science report (2012) also highlighted that without further reforms to govern HFT more effectively, the effects of unstable financial markets could spread through contagion due to increasing globalisation.

There is a genuine worry amongst those in the industry that there are too few rules when it comes to HFT. Very few actually know what is going on in the black boxes which send out the instructions to the various exchange systems, with the potential for defective 'rogue' algorithms to cause issues. There does not seem to be a real understanding of what they are capable of doing. Indeed, with the introduction of HFT, some have compared stock exchanges to eco-systems where things are constantly evolving, increasing the risk of things getting out of hand.

From the secondary research undertaken, it seems that HFT has the capacity to get out of control unless properly managed and regulated, potentially causing an economic catastrophe. Some are fearful that the 2010 Flash Crash was only a quick snapshot of something more sinister which could hit markets. Based on this alone, there is a strong argument to suggest that limited liability is required more than ever to protect shareholders from the systemic risk posed by HFT.

4.0 Conclusion

The nature of investing is changing. In the 1960s, an average share in a company would be held for four years. By the year 2000, this had fallen to 8-months. By 2012, this had fallen to 20-seconds. Electronic trading has been prevalent in markets for some time but the era of HFT has changed things dramatically.

Going forward, it is expected that the popularity of HFT will continue to rise in several major global markets, driven by the growth of independent, proprietary trading firms and quantitative hedge fund strategies.

From the research undertaken, there is little evidence to suggest that high-frequency trading has made the principle of limited liability redundant. There are to too many unknowns and a general lack of understanding about the potential effects of HFT on markets, which in many respects makes limited liability for shareholders more pertinent. Shareholders require some protection. HFTs use of high-tech equipment and algorithms only increases the level of uncertainty around its stability and potential to malfunction which could have a wider impact on market stability. The global nature of markets also amplifies the potential negative impacts of HFT in a specific geographic market, which can easily spread to others.

The Flash Crash in 2010 has helped to make regulators and governments realise that more needs to be done to govern HFT, to ensure that the potential systemic risk it poses is reduced. Argarwal (2012) highlights that specifically in Europe; the European Commission's MiFID Review Consultation document put forth several regulatory proposals on automated trading and HFT in December 2010. Two of the recommendations emanating from the UK Government of Science report (2012) were to introduce market wide standards, primarily to implement co-ordinated and synchronised time stamps (identifying when an event has taken place on a relevant system) across multiple trading venues, as well as establishing a European Financial Data Centre. Their role would be to receive, warehouse and repurpose financial data across all primary European markets.

The noises coming from regulators are positive, however for some, the suggested regulatory changes and updates may be too little too late. When thinking about past stock market crashes, investors often had time to react. In the event of a significant meltdown caused by HFT, it is likely to be over in seconds, giving some investors little time to react. Again, this only confirms that limited liability still has a place in the high-tech age of stock markets. Perhaps we do however need to consider whether or not limited liability goes far enough to protect shareholders from the potential negative impacts of HFT. There are only opinions to suggest that HFT could cause a much wider economic problem but as mentioned previously in this report, it often takes an extreme event to be the catalyst for much deeper, requ regulatory change.

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