

HIGH FREQUENCY TRADING – A REVOLUTIONARY CONCEPT ON FINANCIAL MARKETS

Abstract:

High Frequency Trading has a revolutionary impact on financial markets, by introducing many innovative changes - from the new algorithmic systems (robots) and network connections to the new possible risks and new regulations. This paper explains the concept of High Frequency Trading (HFT), analyzes its origins and evolution, highlights the main drivers of its development and discusses its impact on the financial markets.

Key words: *financial markets, algorithmic systems, High Frequency Trading*

1. Introduction

The financial markets today are an extremely dynamic part of our modern economy. If the financial markets are functioning properly, the economy has the strength to perform also well and the transfer of the financial resources between market participants is done efficiently. The innovative structure of financial markets makes possible to permanently adapt to the economic environment. But the characteristics of financial markets were not like this from the very beginning.

We start from the hypothesis that the financial markets were the object of major changes over the time. We specifically assume that the new approach named High Frequency Trading (HFT) had an important impact over the way market participants are transferring their financial resources.

This paper explains, through a theoretical approach, the concept of High Frequency Trading in the financial markets context, analyzes the origins and evolution of HFT, highlights the main drivers of its development and discusses its impact on the financial markets. All these secondary objectives will be achieved in order to fulfill the scope of this paper, to show that High Frequency Trading had a revolutionary impact on financial markets introducing lots of innovative changes, from the new algorithmic systems (algorithmic robots) and network connections with an amazing speed, to the apparition of new possible risks and new regulations.

The contribution of this paper is to combine and systemize information from the literature written by highly respected theoreticians with facts from the economical reality, facts expressed in newspapers or articles written by highly experienced professionals.

The organization of this paper is as it follows. The second section presents a short history of trading. We define the concept of High Frequency Trading (HFT) and its characteristics in the third section. The fourth part treats the evolution of High Frequency Trading. The fifth part highlights the importance of advanced technologies for the development of HFT. The

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sixth part focuses on the contribution of the HFT in the financial markets context. The final section presents the conclusions of this research.

2. A short history of trading

Since the beginning of securities markets (the early 18th century), all activities were run in a manual fashion. At that time, requesting a quote on a financial security was a difficult, time consuming and expensive action: a client would contact his sales representative in person or, later, via telegraph (1850), via telephone (1975) and through the first available computers (after 1986). The sales representative would then contact the trading representative to request the prices of the securities of interest to the client. The trading representative obtained prices from brokers (physically present on trading floors) and/or exchanges and then this trading representative would report back. [1]. All this process was time consuming, expensive (with all the costs supported by the client) and errors incurred with a high probability (due to human communication).

As modern technology evolved, the National Association of Securities Dealers Automated Quotations (NASDAQ) became the world's first electronic stock market [6]. In 1976, New York Stock Exchange introduced the first electronic execution system, Designated Order Turnaround (DOT). In the next years, computer-based execution has become more and more available, but adopting systematic trading was delayed until the 1990s because of the high costs of computing and because of the low throughput of electronic orders on many exchanges [9]. Electronic Communications Networks (ECNs) were introduced in the 1990s, many financial institutions accepted them and a rapid increase in the proportion of systematic trading took place. In 1992, the Chicago Mercantile Exchange (CME) launched its first electronic platform, Globex, and in 2000 New York-based International Securities Exchange (ISE) launched the first fully electronic U.S. options exchange.

It is not exactly clear when, but researchers admit that a new approach, the investment discipline called High Frequency Trading (HFT) started to evolve in 2005.

3. The “High Frequency Trading” concept

One simple explanation for the concept of “high frequency trading” is the fact that the term itself refers to the fast entry and exit of trading positions [1].

A more complex definition of high frequency trading is given by Martin Wheatley, chief executive officer of the Securities and Futures Commission in Hong Kong and former deputy chief executive of the London Stock Exchange in an article published by The Financial Times [17]. According to Wheatley [17] High Frequency Trading represents “the execution of trading strategies based on computer software or algorithms to capture opportunities that may be small or exist for a very short period of time”. Wheatley [17] also mentioned three important characteristics of HFT: high volume of trades on a daily basis with low level of profits per trade; submitting numerous orders; extreme short stock holding period (positions are usually closed at the end of the day, so no significant open positions overnight).

The last characteristic just mentioned helps us to differentiate Algorithmic Trading (AT) from High Frequency Trading (HFT). Both make use of technology in the decision process, both use computer algorithms to analyze quote data, to take decisions and to optimize trade execution, but positions can be opened for days, weeks, months in AT, whereas positions in HFT are closed at the end of the day. High Frequency Systems are algorithmic, but not many algorithms are high frequency.

It is more beneficial to close the position at the end of the day because it brings savings (the costs to have an open position over the night are eliminated) and it reduces the

exposure to a big risk in the mornings due to the information accumulated over the nights (volatility is usually high in the mornings).

Another characteristic of HFT is that it manages market impact and minimizes the risk by dividing large trades into smaller trades.

Compared to other older investment styles, like the traditional approach Low Frequency Trading, High Frequency Trading is characterized by a very high number of orders with a smaller average return per transaction. This makes the capital turnover to be much faster and bigger. HFT represents a method to diversify investors' portfolios and focuses only on high liquid instruments. HFT reduces the personnel, the associated costs with personnel and reduces the risk of human errors.

In a low frequency approach traders can keep their open positions for a longer period (weeks, months) waiting for the prices to change significantly (at least few %). One single transaction brings considerable returns in this case. Investors adopting a high frequency trading approach will trade more frequently, the rapid submission, cancellations, deletions of orders is imperative so holding periods are very short. The return per transaction is very small (the change in prices is low and the gains are measured in fractions of a penny, for example) but total returns can be considerable since hundred or thousand transactions are executed in one single day.

Under a HFT approach, human beings are not capable to take decisions. Human brain is not capable to function at the speed of HFT, "close to the speed of light" [12]. Also, human emotions, hesitation or distraction could reduce the system's profitability. That is why High Frequency Trading is done by computers, also referred to as silicon traders [14]. The algorithm makes important decisions related to timing, price, and in the majority of cases the orders are executed by passing any human intervention. Computers look for signals like miniscule interest rates movements, economic fluctuations, news, and then algorithms take decisions accordingly. However, human supervision of the systems is imperative in order to ensure that they function properly, without being affected by any virus or by unexpected events. If the boundaries of the system are breached, the human trader is authorized to shut down the system until the situation is fixed. That is the only intervention that a trader can make. All other activities are performed by computers, and human traders are meant only to monitor the trading performance and to decide if the system is performing within pre-specified boundaries, or not.

One good example of what can happen if the activity is not properly supervised is represented by the Knight Capital Group Inc. case. According to Bloomberg.com, this market maker lost \$440 billion on the 1st of August 2012 due to a computer malfunction. A huge number of orders were transmitted to NYSE without having a logic strategy behind, nobody realized what was happening, and in 45 minutes Knight Capital gone bankrupt.

Even if High Frequency Trading approach might seem difficult to understand and to practice, an immense profitability can be achieved. This can be proved with the case of Jim Simons, an investor manager from Renaissance Technologies Corp. According to The Rich List for 2009, published by Alpha magazine [2], Jim Simons reported that he earned \$2.5 billion in 2008 alone. According to Haldane [10] the secret is to be informed and to act "on market prices sooner than competitors. Today it pays to be faster than the average bear, not smarter. To be uninformed is to be slow." And speed is highly related to innovative technology. In order to stay ahead of the competition, traders must make use of the most competitive algorithms.

4. Evolution of High Frequency Trading

According to Financial Times, High Frequency Trading had an ascendant trend which started in 2005. In only few years, it has captured a large share of equity trading volume in the U.S. and a large share of equity value in Europe (Fig. 1 and Fig. 2). Starting with a 21% volume of the entire equity turnover in the U.S., HFT has reached its maximum level in 2009 (61%). Despite the economic recession that started in 2008, HFT added value and it managed to keep developing and generating big profits while the Over-the-counter (OTC) market almost collapsed.

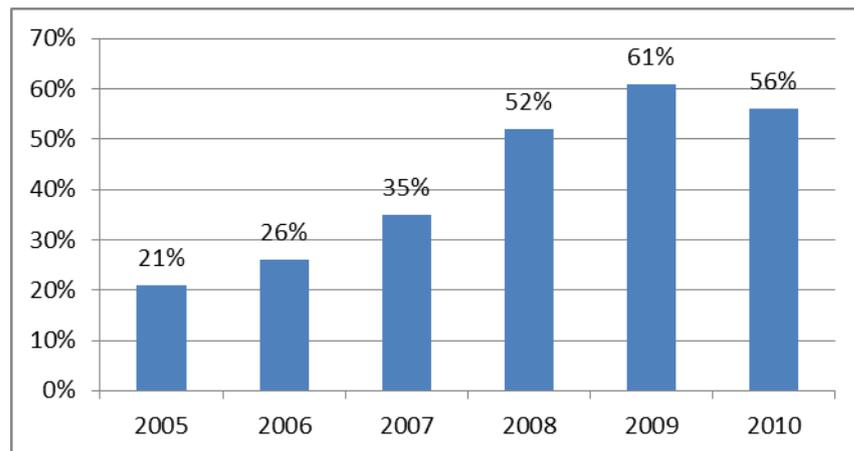


Figure 1: High Frequency Trading market share in the U.S. (as a % of volumes traded)

Source: financialtimes.com

The growth was delayed in Europe, but the compounded growth rate has been over a 106% every year, exceeding the one from U.S.

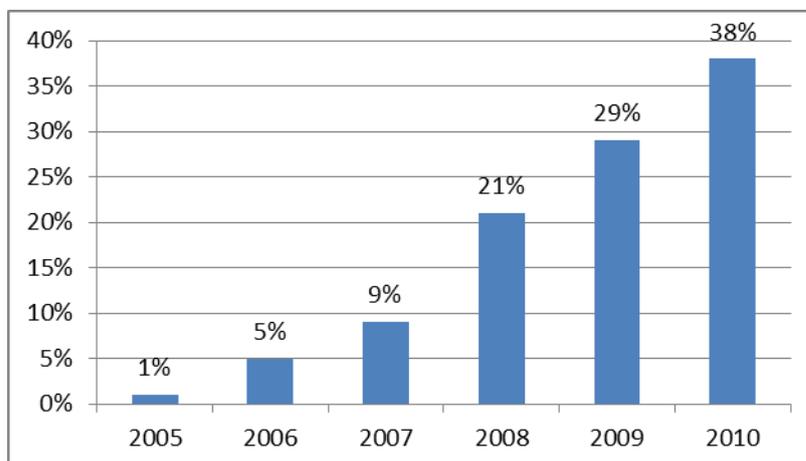


Figure 2: High Frequency Trading market share in Europe (as a % of value traded)

Source: financialtimes.com

The Fig. 1 and Fig 2 indicate that HFT is an important component of regulated financial markets: in the U.S. High Frequency Trading market represented more than 50% of the volumes traded, and in Europe 38% of the total value was traded on HFT systems.

An unexpected event, with a huge market impact, happened on the 6th of May 2010: The Flash Crash. U.S. Securities & Exchange Commission (SEC) and U.S. Commodity Futures Trading Commission (CFTC) published a report with "Findings Regarding the Market Event of May 6, 2010" [16]. The trigger was represented by a sell order of a \$4.1

billion block of E-Mini Standard & Poor's 500 futures contracts on the Chicago Mercantile Exchange. The order was placed by a trader holding long-term positions, not by an HFT firm. The market was already facing some fears due to the Greek debt crisis, and this large sale order only augmented the volatility of the prices on the market. The sale order was placed at 2:32PM. In less than 20 minutes the Dow Jones Industrial Average fell by 900 points and in the following 20 minutes, rebounded almost entirely (fig. 3).

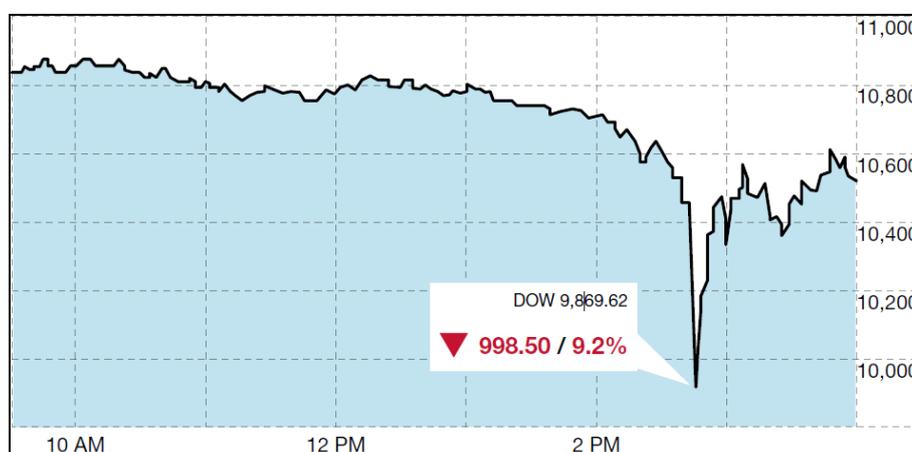


Figure 3 – the Dow Jones Industrial Average, May 6th 2010
Source: cnnmoney.com

After this event, most of the reactions expressed the intention to ban the High Frequency Trading. But this did not happen. The activity (measured in % of volumes traded – Fig. 1) was only reduced because traders knew that HFT brings too big profits to be stopped.

5. The importance of advanced technologies for High Frequency Trading evolution

The growth in HFT has gone hand in hand with a huge development of informational technologies and transaction speed.

The advance of technology has been revolutionary for the way the information is transmitted, stored and processed. Large volumes of intra-day data can be stored, processed and used in real time thanks to new processors that speed up computation and digital communication. Sophisticated new software has been developed in order to speed up and to improve the decision process.

High Frequency Trading firms invest billions per year to buy competitive algorithmic systems called algorithmic robots. These supercomputers allow silicon traders to place orders and to execute them in a matter of milliseconds.

Besides the algorithmic robots, HFT firms invest large amounts of money to improve their communication networks, implicitly the execution time, called latency. Every millisecond (or less than a millisecond) could make a big difference in the level of the profitability of a trader.

The latency or the execution time has decreased significantly from an average of 15 seconds in 2001 to few seconds in 2009 (fig. 4).

After 2010, traders are not interested anymore in seconds, but in milliseconds. According to the press release, “Perseus First to Offer trans-Atlantic Wireless” [5], Perseus Telecom Company launched in March 2013, the fastest Trans-Atlantic network connection, QuanTA™. The direct routes are: New York City, New Jersey, London and Frankfurt. The performance latency is only 67.68 milliseconds with the possibility to be reduced to 67.39

milliseconds in July 2014. What is very important to highlight is that traders are investing billions per year to improve the latency by at least 1 millisecond. Information is the most valuable asset in an HFT approach, and being informed sooner than everyone else means being more profitable than anyone else.

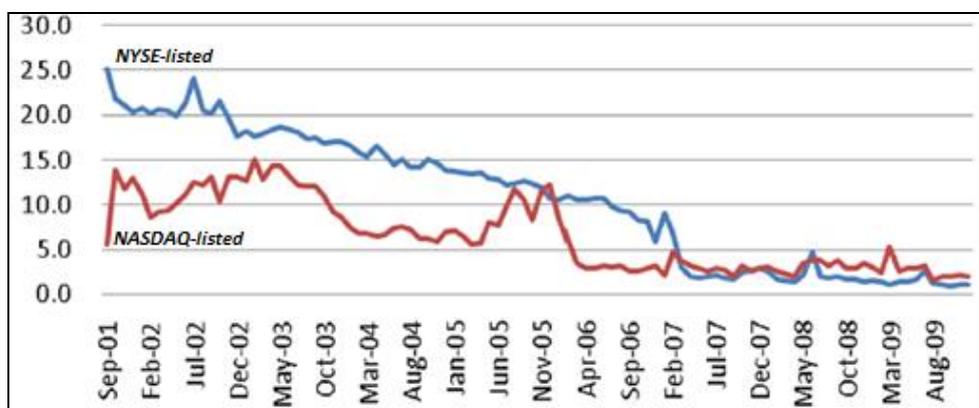


Figure 4 - The speed of execution Market orders

Source: Angel, Harris and Spatt [3]

With all these developments in informational technologies (algorithmic robots and ultra fast network connections) it is literally possible to trade at the speed of light almost. Nowadays, it is possible that every person, no matter the location over the globe, can have information in less than one second and can make profitable trades. This characteristic represents another revolutionary aspect of HFT.

Another way to increase the speed of trades is to purchase real estate as close to securities exchanges as possible. This strategy is called “co-location”. In this way, servers that execute trading strategies will have faster access to the information from exchanges. Few thousand dollars a month are spent for only a couple of square feet of space near the exchanges. Office space in the proximate of the exchanges costs an immense amount, but firms are willing to pay for it because it will help them gaining information more quickly, trading faster and implementing strategies that will bring them large profits compared to their competitors.

6. The impact of High Frequency Trading on Financial Markets

High Frequency Trading has numerous advantages that impact positively the markets, but after some events, including the May 6th Flash Crash in 2010, critics try to highlight the drawbacks of HFT and regulators all over the world try to minimize the potential negative impact that HFT could have on the market structure.

The positive impact of HFT contributes to the quality of financial markets in a few ways stated below. HFT increases liquidity by posting continuous quotes on the market. Volumes increase in this way and traders can “easily move large blocks of shares without running too much risk of prices moving against them.” [15]. HFT reduces spreads by updating the prices of securities more frequently and more accurately. In this way, the risk of outdated quotes or incorrect pricing is almost eliminated. HFT improves market efficiency since prices reflect the information existing on the market more quickly and more accurately. HFT reduces the costs per transaction for large institutional investors and for retail investors as well. HFT reduces human efforts and reduces errors caused by the human factor. HFT encourages the innovation and the performance and supports the development of new algorithm systems, more powerful algorithmic robots, more advanced software and faster network connections.

Small investors experience some of the drawbacks of HFT. They do not have the resources to “co-locate” their facilities or to massively invest in advanced technologies and this leads them to be less informed, not so fast in trading, and their investments are less profitable. Another drawback is the rapid moral depreciation of fixed assets such as algorithmic robots. Large amounts of money are spent to develop and buy high advanced technologies, but in a short time they become obsolete. Despite of large investments, traders are usually in a “technology war”, trying to have a better performance, trying to be faster and smarter than all the others.

Critics of HFT believe that HFT can give rise to price fluctuations and short term volatility. This could be caused by the rapid intra-day trading with open position for only few minutes, or sometimes even seconds. According to a Press Workshop of Eurex Exchange [8], academics have been conducted studies and 6 of them stated that HFT dampens volatility, 7 of them found that HFT has no effect on volatility and only 2 of them accused HFT of causing volatility.

Regulators all over the world could have an adverse impact for HFT. Their main strategies could be: imposing a transaction tax for each trade made and/or ban certain HFT and algorithmic trading strategies. Some of them are already implemented. These regulations could reduce or even stop the profit per trade in the disadvantage of traders. However, as a result of public pressure, the risk of over regulation for HFT is high and the regulatory initiatives are multiple: Markets in Financial Instruments Directive (MIFID), European Securities and Markets Authority (ESMA) Systems & Control, and National Rules. All these initiatives have the main purpose to consolidate the market structure and to prevent market events that could generate a financial crisis.

7. Conclusions

Since the competition, innovation and regulation are increasing, High Frequency Trading is just a natural evolution of the financial markets. Participants adapted to new market structures and conditions, so the phenomenon is not a completely new one.

Some unfortunate events, including the Flash Crash induced the idea that HFT can generate big risks. New regulations were set and the volume of transactions started to reduce. However, High Frequency Trading still has a huge potential to generate profits to traders and still has a huge potential for growth since the overall market structure was positively impacted by the way HFT increases liquidity, reduces spreads, lowers transaction costs and reduces volatility.

The big profitability achieved in the past will determine traders to continue using High Frequency Trading strategies. Also, the important investments in advanced technologies (hardware and software) cannot be wasted. That is why exchanges, regulators and traders need to be more prudent in their future activity, but they should also avoid over-regulation.

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