High Frequency Trading, it's role in the 2007/2009 financial crisis and the 2010 flash crash

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Abstract

High Frequency Trading (HFT) is automation of the conventional securities trades in exchanges that begins by placing limit buy or sell orders, connecting the buyer to the seller and executing the transaction for profit. HFT began in the wake of the millennium and rapidly grew till 2005, later dropping after the 2007-2009 financial crisis; igniting a huge debate. I argue that HFT neither caused the 2007-2009 financial crisis actually occasioned by mispricing of subprime mortgages nor the May 6, 2010 flash crash actually caused by the immediacy problem. That HFT is just an algorithm that attracted mistrust by a section of exchange stakeholders by reason of high speed trade execution. I finally forecast that HFT can only gain more ground after reaching its lowest in 2014, but that it requires regulation to operate in stability.

INTRODUCTION

The ordinary process of securities trading entails receiving a buy or sale order, determining whether the bid-ask spread is within the desirable thresholds of the trader; cognizant of the conveyance costs of brokerage, taxes, exchange rates and other costs. Over time, physical convergence of buyers and sellers in the exchange floor to carry out this process has been replaced by computers which are programmed for parameters like the desired margins, trade size (volume), brokerage fees, taxes and other costs. The programs used are algorithms that command a computer to execute a transaction without human prompting. Traders who subscribe to this form of trading are also known as algo-traders. This operation results in a much easier process that saves time; resulting in a higher frequency of trade filling which has come to be known as High Frequency Trading (HFT) (Krudy, 2010). This conceptual note evaluates HFT activity with a view to establish the trend of its adoption. This will help stakeholders to make the necessary preparations towards institutionalizing ago-trading in exchange markets.

The aim is to evaluate the status of the debate on HFT adoption by traders in transaction execution. This entails an examination of the adoption trends over the last decade and a projection of future expectations. Three objectives have been pursued: first is to assess the status of the HFT debate by reviewing arguments for and against its adoption. Secondly, to find out the relationship between HFT activity and the infamous 2010 flash crash. Finally, I seek to find out the relationship between HFT activity and the 2007-2009 financial crisis.

METHODS

This is a conceptual review of the history and development of HFT, which employs analysis of the process of closing a sale using the HFT algorithm. It may be recalled that HFT entails submission of limit orders, that is, securities orders with preferred minimum sales price and/or maximum buy prices. These figures are plugged into a database containing all the orders submitted. The search engine is   activated which identifies the securities and closes the sale by debiting the relevant buyer bank account and crediting the corresponding seller bank account, both of which are also fed into the algorithm. It may be noted that once the limit orders are submitted, no bargaining window exist unlike where a buyer and seller physically meet. For a physical sale, the purchase price may change depending on the buyer-seller relational chemistry established between them. The key effect is that the 'halo effect' ordinarily established in the case of physical sale, disappears, so that possibility of greater volatility escalates.

DISCUSSION

High frequency trading debate

In 2005, HFT transactions comprised 21% of all exchange traded funds (ETFs) in the United States of America (US). However, by 2012, the percentage had risen to 51% even after the 2007-2009 financial crises. Today, between 50% and 77% of all ETFs in the US and 25% of the Canadian market are transacted through HFT, usually with a Sharpe ratio greater than 10. The growth of computer sophistication in processing time has increased the rate of trading to almost the speed of light. This takes place in as little as 8.5 milliseconds. HFT firms have even moved their servers close to exchanges to further reduce the time and attract more business. HFT has grown to include equity markets, foreign exchange, fixed income markets, commodities and derivatives (Brogaard, 2010). Proliferation of new trading venues, regulation change allowing decimalization, reduced barriers to entry coupled with technological innovation have led to unprecedented growth of HFTs (Moosa, 2016)

Despite HFTs growth over the last decade, a section of finance specialists and practitioners hold dissenting views about this practice. Some feel that it's unfair to deprive traders the novelty of speculating in their business to make profits out of own wit (Bhupati, 2009). Others argue that HFT is dangerous for the markets, while another section like Lotter (2013) support the practice so passionately, quoting Scott Locklin outright dismissal of the cynics against HFT. I submit, in line with the views of Lotter (2013) that HFT is just a computer algorithm that enables high frequency financial data transaction processing and not a trading strategy by itself. This view is shared by Gomber, Arndt, Lutat, & Uhle (2011). A better view would avail by looking at documented advantages and draw backs of HFT.

Arguments for HFT

Top on the list is provision of liquidity. The fact that latency reduces to levels calibrated in milliseconds to a maximum of a few seconds reduces cash holding on assumption that settlement is completed simultaneously. Large share amounts can be purchased through HFT at very small margins. Likewise large amounts of stock can be off-loaded through HFT providing liquidity to the seller in a relatively short time. Secondly, HFT greatly contributes to market efficiency. Efficient Market Hypothesis presupposes inclusion of all public and private information in the stock prices Aldridge (2010). HFT irons out any price discrepancies through arbitrage, hence fostering faster price discovery. A market practicing HFT is a lot less likely to reflect mispriced assets.

Traditional markets possess more asset mispricing on account of information asymmetry compared to HFT markets.

Activities of HFT also lead to lower transaction costs. Most costs are anchored on the bid-ask spread, which is characteristically thin in HFT transactions. Brokerage costs which are sometimes a percentage of the spread grow thinner; and even if they were based on the total stock value, the charges would still be less. HFT transactions are more profitable than the conventional trading. Not on the basis of margin per trade but on the basis of number of transactions per unit time (Aldridge, 2010). Table 1 shows the annualized Sharpe Ratio for various trading frequencies. Clearly, the table shows that higher the frequency, higher the annualized Sharpe ratio. Lowest margins in highest number of transactions yield the highest Sharpe ratio.

Table 1. High Frequency Trading profitability potential

Trading Frequency (Latency)	Average Maximum Gain per period	Range Standard Deviation per Period	Number of Observations in the Sample Period	Maximum Annualized Sharpe Ratio*
10 Seconds	0.04%	0.01%	2,592,000	5,879.80
1 Minute	0.06%	0.02%	43,200	1,860.10
10 Minutes	0.12%	0.09%	4,320	246.40
1 Hour	0.30%	0.19%	720	122.13
1 Day	1.79%	0.76%	30	37.30

*The Sharpe ratio is also called the Reward-to-Variability Ratio measuring excess return per unit of risk.

Source: Ryan Wagna on High Frequency Trading (2016)

Arguments against HFT

It is likely that HFT is used unethically. Traders may engage in market manipulation. Computers are known to be manipulable to the user's advantage. For instance HFT firms may include an extra margin in their favour and hide it within the algorithm. Other kinds of manipulation include creation of fictitious orders to influence real traders to place orders and influence stock prices in a certain direction. A case in point is Trillium Capital HFT (2008) in New York which placed huge orders that it had no intention of following through but used it to deceive other traders that there was high activity in those stocks, inducing them to place more orders hence influencing price (Lötter, R., 2013). Undoubtedly, HFT is unfair to traders with small trade sizes. HFT trade sizes are usually denominated in bulk shares, which facilitate a thin margin to retain the trader in business. On the other hand, small traders do not have sufficient capital to subscribe to HFT firms. Since small firms rely manually in seeking buy or sell orders, they cannot access information the way computers do from the exchange buy and sell orders database. On this basis, small traders are likely to be edged out of business (Aldridge, 2010).

HFT may also lead to flash crashes. An example is the one that took place on May 6, 2010. In this case, a series of global events contributed to a dramatic fall in equity markets (Lauricella, et.al, 2010). It all started with the Greek debt crisis led to a decline in the market less than an hour to 2.45 pm in the US. Other traders felt that the market would continue declining and executed short trades. This activity led to a further sell-off, overloaded exchange systems leading to trading firms exiting altogether. It is important to note that HFT did not in itself lead to the flash crash. Other trading behaviour led to it. The working of HFT has been cited by many a scholar as not yet properly understood (Moosa, 2016). Algo-trading is deterministic; the way 2 multiplied by 4 can be fed into a

calculator to invariably yield a product of 8. If then, following the Greek debt issue, traders instructed the HFT firm to sell-off stock prompted by immediacy (Chacko, Jurek, Stafford, 2008) for lower values but altering the parameters, just to quit the market, which has nothing to do with the algorithm. If the input in the above analogy was 1.5 instead of 2 while retaining 4, the output would be 6 – not the calculator's dysfunction. I submit, in that case, that the flash crash was exogenous to the algorithm Gomber, Arndt, Lutat, & Uhle (2011). Immediacy costs refer to transaction costs related to immediate execution of the transaction (Chacko, Jurek, Stafford, 2008), which expands the bid-ask spread.

Other draw backs of HFT include deprivation of liquidity for stressed markets, increased credit risk where the algorithm does not work, possibility of system failure due to infrastructural overload and increased volatility. Fortunately, it can be argued that not all human problems can be programed. If all could be, then it would mean existence in a deterministic world rather than the reality of a stochastic world. In this connection liquidity of stressed markets may be addressed through independent policy interventions by the relevant authorities. Algorithm dysfunction should be regulated by instituting sufficient firewalls to secure the system by way of regulation including insurance. This measure may apply for system failure as well.

High Frequency Trading and 2007-2009 financial crisis

There is no existing empirical link in literature between the 2007-2009 financial crisis and HFT. However, the HFT market share has declined gradually since the crisis took place. In actual sense, the causal direction is such that the financial crisis affected HFT market share and not the converse (Kirilenko et.al. 2011). This observation may be associated with the skepticism that visited traders since the crisis set in (Kaya et.al, 2017). Traders are not techno savvy. They fear technology that they do not understand. The crisis in question was occasioned by the busting of subprime mortgage bubble in the US. This was human error as opposed to the effect of an algorithm. Since then the market share rising trend prior to this bust turned into a decline since then as shown in figure 1. A closer look at figure 1 shows that the market share has been decreasing at a decreasing rate; possibly at its minimum in 2014, which is still higher than 2007. It is expected that traders' confidence will start increasing in later years. This is on account of high profitability as shown in table 1. From this discussion, it is clear that if HFT market has been declining but the transactions have been increasing, it is small traders that have kept the market; gradually recruiting bigger traders.
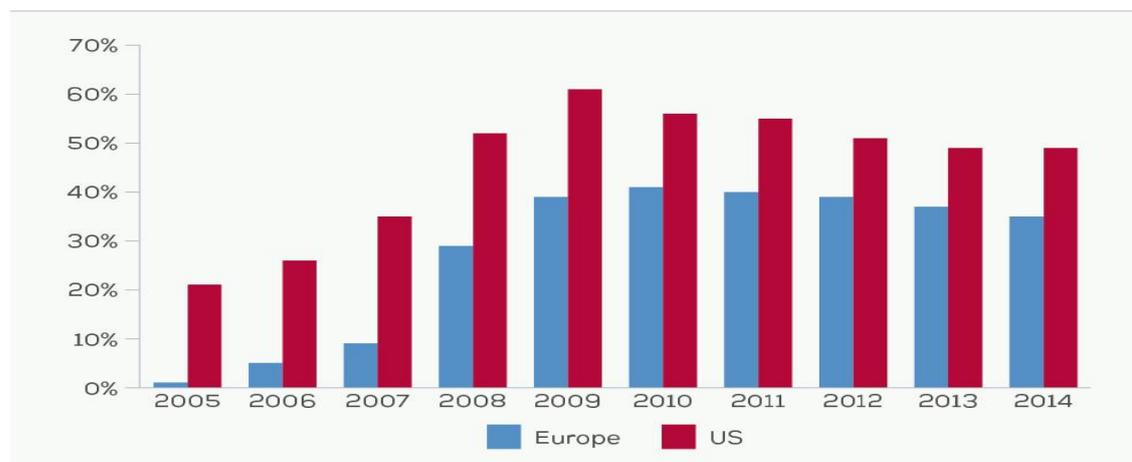

Figure 1. HFT market share with equity before and after the 2007-2009 financial crisis

Source: Orcun Kaya on High Frequency Trading (2016)

HFT regulatory framework

Most of HFT shortcomings can be dealt with by regulation. Currently, HFT firms are governed by Markets in Financial Instruments Directive 2004 (MiFID I). A second edition of the regulatory framework MiFID II is in the offing, to be operational effective January 2018 (Ferrarini & Moloney, 2012). Regulation changes are expected to bear on staff expertise, IT requirements all under organizational requirements. Further, system controls will be enforced to require sufficient capacity and resilient systems, trading thresholds and limits, including proper system testing methodologies. Market abuse is a key area addressed by these regulations with ongoing monitoring of the trading systems. The regulations impose legal obligations for clients of direct electronic access. These include monitoring arrangements, order to transaction ratio and tick sizes. This regulation will hopefully go a long way addressing the fears of bulk stock traders to narrow the gap between them and small traders in terms of trading strategies.

My anticipated contribution as a quantitative behavioural finance scientist in HFT

Conspicuously missing in the HFT scholarly discourse is the behavioural decision making of market players and the asset price forecasting aspects. I posit that there should be a link between the algorithm parameters a trader supplies to the HFT firm and their earnings in the long run. Of course these parameters depict the traders preferred strategies which are a product of their motivations for trading. On the other hand, I feel duty-bound to work on models that forecast asset prices under HFT as accurately as possible justified by the possible rising of the market after 2014 within high frequency financial econometrics.

$$\Delta W = \mu W dt + \sigma W ds \tag{1}$$

where
ΔW = Change in stock price
μ = Average rate of change is the stock price
σ = Stock price volatility
dt = Change in time
ds = A Brownian motion term

The conventional asset price forecasting model is the Ito process depicted by equation 1, a special form of geometric Brownian motion model (GBMM). Black-Scholes-Merton derivatives pricing model derives from it. However, arising from the heightened volatility occasioned by HFT, an additional term is necessary to account for jumps is necessary; and possibly a combination of Markovian methods of GBMM and time series methods Gomber, Arndt, Lutat, & Uhle (2011) may be necessary in HFT asset price modeling illustrated by equation 2.

$$\Delta W = \mu W dt + \sigma W ds + \text{"Jumps"} \tag{2}$$

where jumps are caused by high frequency trading. This equation is neither Riemann nor Ito differentiable by reason of discontinuity.

CONCLUSION

From the above analysis on the debate on HFT and the trends, HFT is making a comeback in market share in a big way while maintaining the transaction share at over 70%. HFT cannot be wished away. Traders have slowly gained knowledge about it and confidence is growing steadily. The initial technical intricacy view by a section of traders is fast waning. The main problem has been erroneous association of financial crises and flash crashes with HFT activity. With the understanding that HFT is just an algorithm that

does not replace the decisions by the economic agent, it is expected to take over ETFs activity for it is just an automation of conventional trading activity in an exchange.

The normal overall effect of automation of processes is that interpersonal interface suffers. However, greater efficiency is harnessed which creates more room for innovation. Information flow is hampered by way of prices not expressing the actual needs of the traders in terms of the difference there would be between physically meeting the buyer/seller and submitting limit orders through HFT. Nevertheless, HFT will continue taking root to facilitate securities' trade globally, facilitating greater allocation of financial resources. This way, an investor in Malaysia can invest in Rwanda from their country and dispose of their investment from any other country of residence.

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