Computer Science and Algorithmic Trading: The Impact on Stock Market Volatility

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Abstract- Computer science advancements provided a way for algorithmic trading in financial markets. It resulted in significent changes in the conduction of trading, having both the advantages and challenges. To the large extent algorithmic trading provided more liquidity and much efficiency to the financial market, at the same time it raised the concerns about market volatility during market stress. This paper investigates the use of algorithmic trading, its impact on stock market volatility, the steps taken by regulatory bodies to manage risks associated with algorithmic trading and high frequency trading. The paper covers some aspects of high frequency trading, statistical arbitrage, smart order routing, artificial Intelligence and machine learning in the financial markets. It explorers the positive effects and negative effects of algorithmic trading on market volatility.

Keywords - *Stock Market, Algo-trading, Volatility.*

I. INTRODUCTION

The financial markets make use of computer science algorithms to execute financial trades based on the predefined criteria. It is called algorithmic trading. In the last few years, with the invention of high frequency trading strategies, algorithmic trading is being used at a large extent. These computer algorithms are capable to execute financial trades at high speeds using the huge amount of data processing. The impact of this technology is that it resulted in the increase of liquidity and reduced the bid-ask spread. But this fast trade execution and transparency concerns in algorithmic trading raised questions about market volatility during the time of market stress.

This paper investigates the impact of computer science algorithmic trading on stock market with covering of the positive and negative effects. It also covers the actions taken by regulatory bodies to control the negative effects.

II. ALGORITHMIC TRADING: AN OVERVIEW

After the financial crisis of 2007-2008, the use of computer science algorithms in trading has been raised to a large extent. In major stock exchanges is worldwide, the method of trade execution by using computer science become a primary process.

High Frequency Trading: Computer science algorithms can be executed at very high speeds using high performance computer systems. It makes use of sophisticated algorithms and high performance exchange servers to minimize latency.

Smart Order Routing: The algorithmic traders can use smart order routing to route orders across separate exchanges and trading platforms to get the best prices available.

Statistical Arbitrage: Small price discrepancies in various stocks and exchanges are captured by the use of statistical arbitrage strategies and market making algorithms.

Artificial Intelligence and Machine Learning: Now the new techniques such as artificial intelligence and machine learning are being integrated into computer science algorithmic trading systems. It will allow the traders to analyse huge amount of data including social media and news to make decisions on trades in real time.

III. IMPACT OF COMPUTER SCIENCE ALGORITHMIC TRADING ON STOCK MARKET

Computer science algorithms are used in trading to automate the process which has both the advantages and disadvantages for stock market volatility:

Liquidity and Market Efficiency Improvement: Computer science algorithms facilitate fast execution of financial trades which improved the market liquidity. Liquidity helps to buy or sell the stocks with much ease, hence reduces the price slippage. When market conditions are normal the improved liquidity results in the reduction of volatility. It helps traders and investors to trade huge amount of stocks without much price changes.

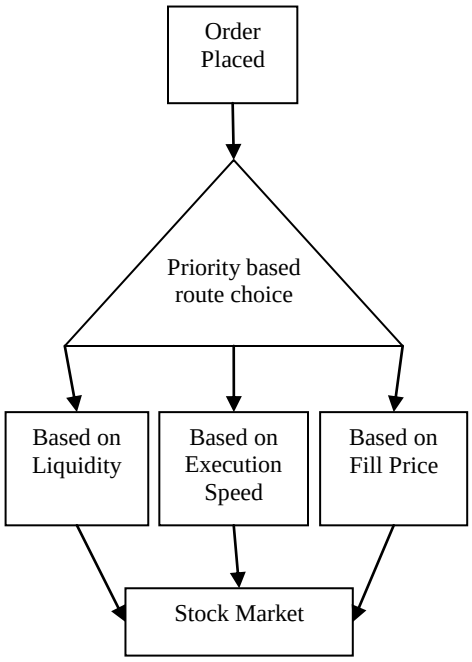

Figure 1. Smart Order Routing

Bid-Ask Spread Tightness: Bid-Ask spreads are the differences in the buy and sell price of the stock. With the invention of computer science algorithmic strategies this bid-ask spread tightened. It helped the traders and investors in reducing the transaction cost. This tightness of market made it more efficient, resulting in the reduction of price volatility.

Price Discovery Efficiency Increased: Since the computer science algorithms can process huge amount of data in real time, these can sharply react to the changes in market conditions and changes in fundamentals. It provided an advantage to the investors and traders in the form of better price Discovery of intrinsic values of stock prices.

Apart from the above discussed advantages of using computer science algorithms in stock markets there are a number of disadvantages of using this technology:

Short Term Volatility Increased: During the time of market stress computer science algorithmic trading has resulted in the increase in short term volatility, while in normal market conditions it improved liquidity. The computer science algorithms executed at high speed and huge volume of stocks result in faster price movements making market swings. As an example, the crash named flash crash of 2010 was a result of high frequency trading algorithms.

Systemic Risks and Flash Crashes: In the past few years a number of sudden and unexplained stock price drops are reported. These sudden events are mostly resulted by algorithmic trading with computer systems and resulted in fast market corrections.

Fragmentation of Market: Another disadvantage or negative effect of algorithmic trading is that it result in trade fragmentation due to the process that trades are routed to multiple exchanges and private trading venues. Due to this the transparency is reduced and it becomes cumbersome to the investors to get the market state in a real time so they get improper information about the market. During uncertainty the lack of market visibility can increase volatility.

Herding Behaviour and Feedback Loops: Volatility is also increased by the feedback loops that are generated by computer science algorithmic trading systems having similar strategies. In simple words, if a number of algorithms are developed to execute on same signal, they will execute in same direction at the same time, which can result in fast price swings. As an example many algorithms may execute simultaneously to trigger sell orders during a market decline.

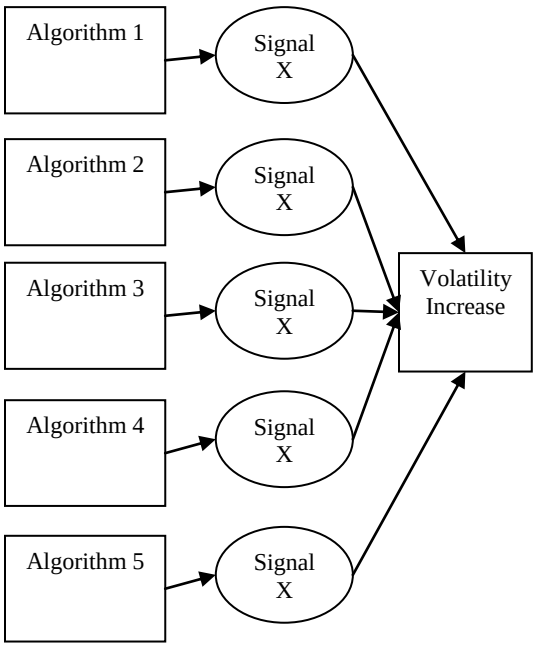

Figure 2. Herding Behaviour

IV. REGULATORY BODIES ON ALGORITHMIC TRADING

As a number of risks are associated with computer science algorithmic trading, regulatory bodies worldwide took some steps to control the negative impact on market volatility:

The Volcker Rule: After the financial crisis of 2008, in 2010 Volcker Rule was introduced as part of Dodd-Frank Act in US. The rule was introduced to prohibit financial Institutions from doing proprietary trading and hence control risky activities. It includes the imposing of rules on all banks and other financial entities.

Circuit Breaking: US Securities and Exchange Commission in 2012 introduced circuit breakers in the market so that in the case of extreme market volatility the trading can be halted. It was introduced to prevent the flash crashes by pausing the trading and allowing the market to stabilize.

Order Routing Regulations: Many rules were introduced by regulators to ensure that the trades will be best executed for the clients. It also includes making available the best prices of stocks at all trading venues. The purpose was to manage and control the market fragmentation and provide efficient and fair functioning of the market.

V. CONCLUSION

The stock market is significantly impacted by computer science algorithmic trading providing both positive and negative impacts. At one side it improved liquidity, improved price discovery efficiency and reduced bid-ask spread, on the other side it increased volatility in times of market stress. Use of computer science algorithmic strategies and other high frequency trading result in flash crushes, market fragmentation and feedback loops. To overcome the negative effects the regulatory bodies introduced a number of control measures such as best execution rules and circuit breakers to control the risk related to algorithmic trading.

Algorithmic trading is directly related to computer science and so as the technology will continue to evolve it will remain a crucial part of financial markets. So in the future the market regulators will have more responsibilities to create a balance between adapting the innovation and ensuring the market stability. More deep research is needed to evaluate the long term effects of computer science algorithmic trading and the effectiveness of regulations on financial market practices.

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