

Algorithmic trading – Rise of machines on the trade floor

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Abstract--Technology has changed the face of the financial world today. Core banking solutions, mobile and internet banking, real time gross settlements, high tech stock exchanges have revolutionised the way the financial systems work today. The same revolution has had a massive impact on the way the stock exchanges function today.

This paper tries to analyse the impact on stock exchanges by technology. First it tries to analyse the introduction of technology, post which the paper analyses the development on the technological front. The crux of the paper is towards algorithmic trading or no human intervention trading.

Algorithmic trading has been on a rise and it is estimated that around 40 percent of the trades made on the London Stock Exchange (LSE) now originate from algorithmic trading systems. About 15 percent to 20 percent of buy-side firms have adopted algorithmic trading broadly, and they are using it within the confines of their Order Management System (OMS) workflow.

PAST RESEARCH

Ernest P. Chan (2009) has done a quite interesting study on quantitative trading which also includes development of algorithms and using a software package like MATLAB as a development platform.

Terrence Hendershott and Ryan Riordan (2011) have analysed the impact of Algorithmic trading by studying 30 stocks in the German market. A very vital conclusion is reached for which shows the traders should be careful with the spread offered in the algorithmic trading otherwise liquidity in the market will be impacted.

Alain Chaboud and Benjamin Chiquoine have studied the effect of Algorithmic trading on measuring of price efficiency, frequency of triangular arbitrage opportunities and excess volatility with respected to liquidity.

David L Kornblau , Allison Lurton and Jonathan Sperling have studied the regulations of the stock market that may impact algorithmic trading. Computerised trading with the help of algorithms will always be limited by market regulations. This avenue is studied in this paper which adds the order limit to algorithmic trading.

Researches have mentioned about both the positive and the negative impact of the algorithmic trading. Alongwith such studies we have researchers like

Prof. David Cliff (1996-97) and Steven Gjerstad & John Dickhaut (1997-8) who have developed the “ZIP” and the “GD” algorithm respectively which have been proved to outperform human traders.

RESEARCH METHODOLOGY

This paper is a conceptual and descriptive paper where emphasis has been laid on studying the framework for algorithmic trading and the problems of latency and liquidity.

Introduction of technology in the stock exchanges around the globe –

This below details has been taken from one of the earlier papers written on the technological impact on the stock exchange by me published in the IBMRD’s Journal of Management and Research. It basically shows the timeline of introduction of technology. The stock exchanges were chosen based on the equity domestic market capitalisation which narrowed down the search to 12 from around 54 stock exchanges around the world.

NYSE

1878 marks then the first telephone installed on the NYSE, 1978 Intermarket Trading System (ITS) is inaugurated. ITS provides an electronic link between the NYSE and competing exchanges, enabling brokers to access all markets nation- wide to find the best purchase or sale price for a security and currently a unique blend of floor based auction and electronic trading is introduced through the hybrid market.

NASDAQ

In 1976 NASDAQ purchased the assets of the automated quotation NASDAQ System from its builder and operator, Bunker Ramo Corporation and slowly by the start of the 20th century a state of art market platform is launched.

Tokyo SE Group

1982 can be marked as the start of the computer phase for the Tokyo SE and the exchange saw a full-fledged computerisation by 1999.

London SE Group

The market deregulated in the 1986 termed as the ‘Big Bang’ where instead of human outcry for

trades the computers were introduced and screen based trading started.

NYSE Euronext (Europe)

Technology wise it would be similar to the NYSE. In 2007 a merger between NYSE and the Euronext created a truly global marketplace.

Hong Kong Exchanges

Two important dates for the same being 1986 with the launch of CATs and 1993 with the introduction of AMS. (CAT – Computer Assisted Trading systems and AMS – Automatic Order Matching and Execution System)

Shanghai SE

Shanghai SE heavily relies on HP for the servers and other computer related equipment. It's an entirely paperless trading mechanism. There are terminals on the trading floor as well as the member firms.

TMX Group

The TMX group consists of two stock exchanges the Toronto SE and the TSX Venture exchange. In 1977 Toronto Stock Exchange launched the world's first Computer Assisted Trading System (CATS) and in 1997 Toronto Stock Exchange became the largest stock exchange in North America to choose a floorless, electronic (or virtual trading) environment when its trading floor closed.

Deutsche Börse

Headquarter in Germany this Stock exchange introduced electronic trading for a limited amount of equity in 1991 and in 1992 BOSS, an order routing system was introduced to support trading. Banks and firms were able to forward orders electronically with this feature. The earlier system outcry was abandoned future onwards. A lot of trading systems including the Xetra have been seen used since then.

Australian SE

Stock Exchange Automated Trading System (SEATS) was introduced in 1987. In 1998 the SE was demutualized and it was the first SE in the world to do so. Today it works on the following trading platforms ASX Trade (equity securities) and ASX Trade24 (derivative securities trading). As per the Australian Securities Exchange Review on algorithm trading, there has been a significant increase in trading activity in the recent years and also a reduction in the average trade size.

BSE India

In the year 1995 the electronic trading was introduced within a time span of 50 days. This fully automated computerized mode of trading is known

as BSE Online Trading (BOLT), a system both order and quote driven. BOLT was operational using screen based trading and it switched over to the direct online access facility in September 1997. In the infant stages BOLT was available to brokers of the BSE based in Mumbai through leased lines. Today, it is available all over the country and even abroad. The year 2000 witnessed the introduction of derivatives on the market platform.

The National Stock exchange (NSE)

NSE was incorporated for the first time in November, 1992. A significant milestone from the technology front is that the National stock Exchange has received the BEST IT USAGE 6 award by the computer Society of India in the year November, 1996. It has also received an award for the TOP IT USER in the name of "Dataquest award" in year December, 1996.

ALGORITHMIC TRADING (AT)

In a circular issued by SEBI for guidelines to be followed for algorithmic trading it defines algorithmic trading as any order that is generated using automated execution logic shall be known as algorithmic trading. This part forms the crux of the paper. By the start of the 21st century the computer had dramatically changed the way the world trades and this financial engineering still had to make some revolutionary changes. The 21st century witnessed algorithmic trading – a new financially engineered product for automated trades without human intervention.

STUDY OF AT ACROSS THE GLOBE

Earlier the technological revolution in stock markets has been discussed. The new development was automated trades itself. Algorithms are now seen widely been used for even intraday trading. For any trade to get executed four parameters revolve around the same – Price, Quantity, Market forces and Time of execution. A computer programme that can balance these four parameters without incurring a loss for the trader can be suitably called a successful algorithm. (In a computer language a step by step procedure to reach the optimum solution is termed as an algorithm)

The earliest reference available on Algorithmic trading is of Dave Cliff, Janet Brutent (1996-7) developing a ZIP algorithm. People using this algorithm are called the ZIP traders (zero intelligence plus traders). Also the "GD" algorithm by Steven Gjerstad & John Dickhaut (1997-8) proved that algorithm can be counted over human trading behaviour. The GD algorithm Many papers were published by them under the umbrella of IBM and HP related to the way automated trading can work in an open market including the ZIP and the GD. If a trace back is done to find out the way

stock trading happened, two theories come to limelight. Few traders used fundamental analysis as a benchmark for investing in stocks and few performed technical analysis with tools like oscillators and various charting techniques. The fundamental analyst tries to find the intrinsic value of the company's share based on the financial statements and the annual reports of the company. Depending upon the intrinsic value and the market price the decision is taken of whether the share is undervalued and overvalued. On the same basis it is either bought or sold. Fundamental analysis takes a longer time since it involves n number of parameters and also judgement.

Technical analysis is more mathematical in nature. By following certain rules and the market movements the decision of buy or sell can be taken. The technical analysis is based on three fundamental assumptions 1. The market discounts everything 2. Price moves in trends and 3. History tends to repeat itself. Based on this certain charts are drawn representing trends, supports, resistances and oscillators. With the help of certain rules mapped to the market movements decisions are taken on buying and selling the stocks. Algorithmic trading can be said to be an extension of technical analysis with the help of technology.

In this paper we describe three algorithms which are very popular in trading circles –

VWAP trading

One of the most popular trading happening currently is the VWAP trading (Volume Weighted Average Price trading). In this the following calculation is involved

1. Average price paid per share during a period
2. Volume of shares traded during that period * Avg price = VWAP
3. Fixed number of shares * Price close to VWAP – Decision

In this it is very easy to feed a particular number of shares in the system to be bought and sold. Similarly a computer programme can run to find VWAP for a particular period and then the transaction executed.

TWAP algorithm

TWAP (time weighted average price) is the average price of securities / shares over a specified time. Calculation - Average the open , high , low and close prices for each bar and then calculate the average of those averages as time progresses.

PERCENTAGE OF VOLUME ALGORITHM

PoV (Percentage of Volume) algorithm solves the issue of VWAP by using the actual traded volume of the day as benchmark. The idea is to have a constant percentage participation in the market along the trading period. If the quantity that

remains to be traded is Q, and the participation ratio is P, the algorithm computes the volume V traded in the period (t- ΔT, t) and executes a quantity $q = \min(Q, V * P)$

In the above paras the algorithms have been simplified for explanation. But some computational mathematics gets involved as the market forces will be changing in each period, so the past circumstances will not remain stagnant for the execution period, and that should be considered in the algorithm. This is done by using some computational mathematics.

Other sophisticated algorithms include Almgren-Chriss order-splitting algorithm, Almgren and Harts algorithm, ZIP algorithm and GD algorithm.

MARKET IMPACT

Whether the trade happens algorithmically or manually one thing surely to get impacted is the volatility and the liquidity in the market. As algorithmic trading is computer generated it can cause huge volatility in the market even leading to a crash. Extreme volatility on May 6, 2010 had raised questions in the US financial markets regarding high frequency trading (High-frequency trading (HFT) is the use of sophisticated technological tools and computer algorithms to trade securities on a rapid basis). Analysts concluded that HFTs did not trigger the Flash Crash, but their responses to the unusually large selling pressure on that day exacerbated market volatility.

Technical glitches are always a concern in any domain and if the glitch happens due to a computer program the damage would be beyond measure. Thousands of dollars are exchanged between buyers and sellers on a daily basis on the stock exchange. All these can be at stake with a wrong computer program and so caution is a must. Also many instances have been seen worldwide wherein the computer program can go bizarre causing huge losses to firm itself. Also the basic fundamental analysts who are actually going through the financial statements of the company and then investing would lose out making the foundation of an organisation go weak.

“The New York Stock Exchange (NYSE) has censured and fined Credit Suisse Securities (USA) \$150,000 after one of the algorithms used by the broker's proprietary trading desk sent hundreds of thousands of erroneous messages to the bourse, freezing the order queue and delaying the close of five floor trading posts.”⁴ This has happened in 2010. In 2011 we also have seen SEBI issue a circular for algorithmic trading rules. All the stock exchanges worldwide are currently working on rules and regulations that algorithmic trading, high frequency trading are kept at a level that the market maintains its stability. The above example of Credit Suisse getting fined is only such illustration.

The governing system of the stock exchanges should help them cope with the increase in use of algorithmic trading. Also restriction on the number of trades which use algorithms should be kept as a parity check point.

CONCLUSION

Algorithmic trading has already made its mark on the stock exchanges and will only be growing in size in the years to come. We cannot imagine going back to the outcry mechanism on stock exchanges but we also cannot deny that computer related actions if not supervised will collapse the financial system. Algorithmic trading should be permitted but with proper rules and regulations. Plus restrictions over trade numbers and trade volumes should be ensured to ensure sustainability in the market. Financial engineering should happen but implementation should be supervised to try and keep the system intact. Technological changes should be welcomed in the financial system with robust implementation rules and a strong system to deal or handle sudden technical glitches.

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