Algorithmic Trading: A Study

Rachana Sharma, Assistant Professor, Jaipuria Group of Institutes, Vasundhara (GZB)

ABSTRACT

All across the investment banking industry there is a buzz with talk of algorithmic trading. Algorithms have become common feature in the trading landscape. These techniques can be defined as the placing of a buy or sell order of a set quantity into a quantitative model that automatically generates the timing of orders and the size of orders based on goals specified by the parameters and constraints of the algorithm. These mathematical models analyze every quote and trade in the stock market, identify liquidity opportunities, and turn the information into intelligent trading decisions. Algorithmic trading, or computer-directed trading, cuts down transaction costs, and allows investment managers to take control of their own trading processes. It is a style of trading and not a separate business.

This paper discusses the various popular trading algorithms, the trends, area of concern and impact of algorithmic trading. Algorithm innovation continues to offer returns for firms with the scale to absorb the costs and to reap the benefits.

Key Words: Algorithms, trading, liquidity.

INTRODUCTION

Over the past few years there has been a rapid increase in the volume of trading done by algorithms. This can be easily gauged from the fact that in the premiere stock markets of the world like New York Stock Exchange and London Stock Exchange more than 40% of the trading being done in 2009 was through algorithms. Although in India, it is in introduction phase. Lehman Brothers First introduced it in 2008. Still, this new trend has led to an explosion of sorts with more and more world economies including India adapting to this change. Algorithmic trading can be defined as “placing a buy or sell order of a defined quantity into a quantitative model that automatically generates the timing of orders and the size of orders based on goals specified by the parameters and constraints of the algorithm”. The rules built into the model attempt to determine the optimal time for an order to be placed that will cause the least amount of impact on the price of the financial instrument. Algorithmic trading is a way to codify a trader’s execution strategy. Algorithmic trading or computer-directed trading cuts down transaction costs and allows fund managers to take control of their own trading processes.

OBJECTIVE

The main objective of this paper is to study the various trading algorithm, their trend and the main area of concern for the implementation in Indian Capital Market.

COMMON TRADING ALGORITHMS

In practice the most commonly used algorithms in the market place are: arrival price, time weighted average price (TWAP), volume weighted average price (VWAP), market-on-close (MOC), and implementation shortfall.

Arrival Price
Arrival price is the midpoint of the bid-offer spread at order-receipt time, and it also notes the speed of the execution.
VWAP (Volume Weighted Average Price)
When a bulk order is placed the algorithm breaks it into several smaller orders according to the historical data as computed to be optimum. VWAP is calculated by adding the amount traded for every transaction in terms of price and multiplying that by shares traded, and then dividing that by the total shares traded for the day. It is particularly useful when the trader is not able to gauge the current market trends

TWAP (Time Weighted Average Price)
This model is a special case of VWAP model. Here we assume that market position would be stable all through the day. The bulk orders are simply broken on the basis of time. Generally there is a constant time gap between the orders placed. For example an order is placed every 20 minutes. Here brokers need to adjust the time slices taking care that the order is completed.

MOC (Market on Close)
MOC measures the last price obtained by a trader at the end of the day against the last price reported by the exchange. This algorithm is useful in the financial derivative markets and securities which are auction based. In general this algorithm is used when trading is to be started after a particular time. Like in the case of auction based trading, bids are accepted after the starting time only. It functions on the basis of a time trigger, Algorithm waits for the time trigger and starts functioning after that.

Implementation Shortfall
Implementation shortfall is a model that weighs the urgency of executing a trade against the risk of moving the stock.
Most algorithms already allow customers to change the timing of executions, the rate of order-filling attempts at the beginning or end of the trading day, and the tolerance for the slippage of a stock from certain benchmarks.

Major companies with their preferred Trading Algorithms

<table>
<thead>
<tr>
<th>Company</th>
<th>Algorithms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldman Sachs &amp; Co</td>
<td>VWAP, VWAP Lite, TWAP, 4CAST (implementation shortfall), Percent of Volume, Piccolo (execution of small orders), Scaling, Gamma Hedge, Delta Hedge</td>
</tr>
<tr>
<td>BNY Brokerage</td>
<td>VWAP, TWAP</td>
</tr>
<tr>
<td>Citigroup Global Corporate and Investment Bank</td>
<td>VWAP, Cost Minimization, and Smart Market</td>
</tr>
<tr>
<td>FlexTrade Systems Inc</td>
<td>VWAP, TWAP, Target Volume, Sensitivity, Order Staging Model, Arrival Price</td>
</tr>
<tr>
<td>JPMorgan</td>
<td>VWAP, Target Volume, Advanced Pegging</td>
</tr>
<tr>
<td>Nomura</td>
<td>VWAP, TWAP, With Volume, Target Strike, target Close, Wait and Pounce, Auto Reload, Spread (Pairs) Trader</td>
</tr>
</tbody>
</table>

SRATEGIES
Following are the basic strategies which are used for developing an algorithm:

Trend Following
Trend following is an investment strategy that tries to take advantage of long-term moves that seem to play out in various markets. The system aims to work on the market trend mechanism and take benefit
from both sides of the market enjoying the profits from the ups and downs of the stock or futures markets. Traders who use this approach can use current market price calculation, moving averages and channel breakouts to determine the general direction of the market and to generate trade signals. Traders who subscribe to a trend following strategy do not aim to forecast or predict specific price levels; they simply jump on the trend and ride it.

**Pair Trading**
The pairs trade or pair trading is a market neutral trading strategy enabling traders to profit from virtually any market conditions: uptrend, downtrend, or sidewise movement. This trading strategy is categorized as a statistical arbitrage and convergence trading strategy.

**Delta Neutral Strategies**
In finance, delta neutral describes a portfolio of related financial securities, in which the portfolio value remains unchanged due to small changes in the value of the underlying security. Such a portfolio typically contains options and their corresponding underlying securities such that positive and negative delta components offset, resulting in the portfolio's value being relatively insensitive to changes in the value of the underlying security.

**Arbitrage**
In economics and finance, arbitrage is the practice of taking advantage of a price difference between two or more markets: striking a combination of matching deals that capitalize upon the imbalance, the profit being the difference between the market prices. When used by academics, an arbitrage is a transaction that involves no negative cash flow at any probabilistic or temporal state and a positive cash flow in at least one state; in simple terms, it is the possibility of a risk-free profit at zero cost.

**Mean Reversion**
Mean reversion is a mathematical methodology sometimes used for stock investing, but it can be applied to other processes. In general terms the idea is that both a stock's high and low prices are temporary, and that a stock's price will tend to have an average price over time. Mean reversion involves first identifying the trading range for a stock, and then computing the average price using analytical techniques as it relates to assets, earnings, etc. When the current market price is less than the average price, the stock is considered attractive for purchase, with the expectation that the price will rise. When the current market price is above the average price, the market price is expected to fall. In other words, deviations from the average price are expected to revert to the average.

**Scalping**
Scalping (trading) is a method of arbitrage of small price gaps created by the bid-ask spread. Scalpers attempt to act like traditional market makers or specialists. To make the spread means to buy at the Bid price and sell at the Ask price, to gain the bid/ask difference. This procedure allows for profit even when the bid and ask don't move at all, as long as there are traders who are willing to take market prices. It normally involves establishing and liquidating a position quickly, usually within minutes or even seconds.

**ALGORITHM DEVELOPMENT PROCESS**
Development of algorithms involves a high level of collaboration with the client as algorithms are meant to meet the trading strategy objectives of the trader. Algorithms are meaningless if the strategies don’t perform. The basic processes involved are: closely interacting with the users to understand their strategies, creating an algorithm based on the inputs, presenting the client with results of back tests and analysis using historical tick-level data. The algorithm is then released to one or two beta clients, who begin to use it on small volumes of live trades. From that point the vendor and the client will engage in
a period of iterative feedbacks during which they conduct post-trade analysis to ensure that the desired results are being achieved. The final product is moved up and down the development chain with constant feedback from the end user. Once the required results are obtained the product is finalized. The basic fact to remember is that the client is just interested in results and they demand good performance, speed of execution. So the manner in which an algorithm is tested or the manner in which it is implemented is rarely of concern to the trader.

**IMPACT OF TRADING ALGORITHM**

Access to liquidity is improved as algorithms provide Direct Market Access (DMA) to the opportunities (exchanges/other markets) which offer most favourable prices and liquidity. DMA offers better access to the financial securities to the buy side firms who may want to buy or sell in the respective markets. Algorithms optimize the access in such scenarios where multiple trading venues are concerned. This has further implications as it often results in an improved efficiency for market makers such as banks. This has also lead to a decrease in fragmentation of the market. There is a change in employment patterns as traditional securities experts are replaced by algorithm experts for operation and maintenance of the platform.

**ALGORITHM TRADING TRENDS & FUTURE**

Many trading firms continue to develop in the algorithmic trading market. The market itself is growing as familiarity with the commodities asset class grows, an increasing number of investors are recognizing the value of taking a more active approach with their investment strategy. Falling in with the global trends now the Indian markets have also started to incorporate the fundamental of algorithmic trading in its operations. It was first introduced in India by Lehman Brothers Inc. Recent players in this segment include Goldman Sachs, Credit Suisse and JP Morgan. One of the bottlenecks in fast implementation in Indian markets has been that the algorithms need to be submitted to Securities Exchange Board of India (SEBI) for scrutiny. But brokers generally are unwilling to submit such classified information about the algorithms that they have invested a lot in developing.

The Indian markets are a unique challenge for algorithmic trading as low visible liquidity on the bid and offer, and high trade rate all require a lot of effort and skill to execute a good trade.

Goldman Sachs estimates a strong demand for electronic trading, particularly via algorithmic strategies. According to them more than 90% of the equities electronic trading volume is now directed to algorithms as compared to straight-to-market orders.

To meet the future demands, we must incorporate:

*Algorithmic innovation, not adoption, is state-of-the-art:* An innovative algorithm approach is necessary for the future as only the adoption for algorithm is not enough to meet the frequently changing demands of the capital markets. Only the firms that can introduce new algorithms quickly will stay ahead.

Markets are governed by news, therefore the algorithm that are able to react quickly with market news would be going to be more beneficial.

*The optimal combination of algorithms:* Algorithms need to be combined optimally to have an appropriate trade-off between Risk and Return.

*The rise of the buy-side as an algorithmic powerhouse:* the buy-side is demanding increased anonymity and control over their trading strategies. With algorithmic trading being adopted by firms of various shapes and sizes, the need for technology that supports unique trading techniques will continue to grow.
Algorithmic everything: the convergence of the front and back office: Now, firms are beginning to incorporate traditionally back office functions, such as changes to foreign exchange risk exposure, into their front-office operations.

AREA OF CONCERN

Lack of Visibility
We know what a specific algorithm is supposed to do, measure its pre-trade analytics and see how the post-trade results match up to that expectation. But if the trader didn’t select the most optimal algorithm for that trade little can be done. This problem is caused by a lack of visibility and transparency into the algorithm while it is executing orders.

Algorithms Acting on Other Algorithms
If fund managers’ trading pattern is spotted and regular; tracked with the use of algorithms, then these algorithms are liable to be ‘reverse engineered’. This implies that their buy and sell orders are pre-empted and used to the maximum effect by their competitors. Here, algorithms are acting on other algorithms.

Unfair Advantages to large institutional investors
Algorithms observe the trends in the market and place order in the order of seconds. The other advantage that they offer is a significantly lower transaction costs. Both these coupled together give a decisive edge to the investment giants over smaller brokers and investors. The cost of developing, implementing and hiring software professionals to maintain algorithmic trading platform with minimum basic features and develop subsequent infrastructure may cost a broker between 5-10 million $. Naturally this is unaffordable for them while bigger investors profit due to operations on economies of scale

Black Box Algorithms
In most of the algorithms, the user is just required to enter the timing and quantity of the purchase. They are unaware of how the trade is being executed. There may be cases where the buying or selling done by the algorithm may not be optimum in the given circumstances. Therefore users may not be confident about the purchase. There is a need of more transparency while execution.

Selection of Appropriate Algorithm
Currently a lot of literature has been generated on various algorithms for trading. Most of them function on different set of parameters. This makes it hard for the brokers to understand algorithms which suit their needs and make optimum predictions based on the current specifications. Time and again need has been felt of a benchmark that would compare different algorithms. For example a broker may have a time constraint, so he would have to select the algorithm which would return optimum values. Also careful calibration is required so that it is most useful for the broker. Different traders place different importance on factors like timing of the order, price and size. Algorithms should be able to replicate those needs so that they may be able to best fit the trading strategies of the trader.

The Human Touch
Algorithms are trading tools where various parameters are weighted in to make predictions. But stock markets have traditionally functioned on the understanding and experience of traders who alter their strategy according to different situations. Algorithms cannot replicate the gut feel element of human nature wherein they decide on the strategy on whether to be more aggressive or subdued. Also human reaction to an unexpected situation is better than an algorithm. Banks have been devoting huge funds so that algorithms may come as close as possible to mimicking human reactions in unanticipated situations. Soon we will have adaptive algorithms that adjust their execution at each moment in time in response to what they see happening in the market just as a human trader.
CONCLUSION

Algorithms are widely recognized as one of the fastest moving bandwagons in the capital markets. These are very important for emerging economies like India as number of small investors in our economy is too huge considering smaller brokerage firms and individuals investors. The algorithmic trading would be in great demand by the small investors once the human interaction of these algorithms would be enhanced which a great limitation of these algorithms presently worldwide. In today’s hyper-competitive, cost-conscious trading environment, being the first to innovate can give a broker a significant advantage over the competition both in capturing the order flow of early adopters and building a reputation as a thought leader.

These algorithms can also be integrated in the present GUI of the brokerage firm present in India like Sharekhan.com and India bulls so that small investors would also be benefited by these algorithms advanced market prediction and analysis. Algorithmic trading has had a profound impact on the way trading is done. It has led to globalization of markets and reduced transaction costs per stock. This has also resulted in increased trading volumes. There are tremendous growth opportunities in this form of trading but a few areas of concern need to be addressed before it becomes more widely accepted amongst the investing community.

REFERENCES

- Goldman sachs enhances algorithm trading offering in India http://gset.gs.com/cgibin/upload.dll/file.pdf?z0412210az2a59234840b4a57b03995d6191ecb07
- Algorithmic trading gets a second wind, By Sachin P Mampatta Jun 29, 2009