RESEARCH INSIGHTS

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Algorithmic Trading
Does it Improve Markets as a Whole?

Executing thousands of trades in a blink of an eye, making decisions ten times faster than what a human can react to. Even when investors are asleep, they keep an eye on the market, making minor adjustments to hedge their positions in the ever-evolving market

Abstract

Algorithmic Trading has been on the rise over the past three decades; although the full impacts are not well understood, we have empirical evidence that Algorithmic Trading helps improve the market in a few aspects. In this paper, we examine the consequences of ATs being a part of the financial ecosystem. The implementation of ATs not only spans the equity market but also in futures and foreign exchange markets; in each of these markets, the impacts of ATs are homogenous throughout. While some studies argue that ATs benefit market participants and market stability, others have highlighted the growing risks of strange events occurring from the black box. Overall, ATs have helped improve the market quality by improving liquidity, improving price discovery, and ultimately lowering the costs associated with Trading. ATs not only would help investors optimize returns but also strengthen the resilience of the markets for authorities.

Introduction

Algorithmic trading is automated trading by computers programmed to take specific actions in response to varying market data. They utilize complex logic, combined with proven mathematical modeling and an element of human oversight, to make decisions to buy or sell financial instruments, mainly on an exchange. Algorithmic trading systems often make use of high-frequency trading (HFT) technology, which allows a company to make thousands of trades per second. These systems can be used in various situations, from order execution and arbitrage to implementing trend trading strategies. Hedge funds and large banks are not the only users of Algorithmic Trading nowadays., the average retail investors are also starting to adopt ATs as well. Retail brokers have used them to maximize price discovery by providing the best bid-ask quote in the electronic trading network in that instance. Thus, retail investors will be able to access the theoretically best price for their trading.

Although one may think that Algorithmic trading is a relatively new concept or system, in actual reality, their introduction was synonymous with the computerization of securities trading. Algorithmic trading was introduced in the 1970s alongside the computerization of the New York Stock Exchange to reduce overall settlement time from 5 business days to 3 business days. By the 80s, primitive versions of algorithmic trading systems had been implemented by mutual fund companies to simultaneously execute a basket of orders.

By accepting electronic orders, this development has opened up the possibility of algorithmic trading.

In Algorithmic Trading, there are two main categories these algorithms fall into Agency and Proprietary. Agency trading algorithms are used by financial institutions such as fund management companies, brokerage firms, and even pension funds. They can be used to split large-sized orders known as block orders to minimize the market impact, save on transaction costs, and mitigate volatility risks. Proprietary algorithms, on the other hand, use pre-programmed software to handle its decision-making when executing trades. These algorithms can be opportunistic or market-making in nature; with opportunistic algorithms, these systems are meant to derive revenue from making speculative or arbitrage trades; they can implement statistical arbitraging, directional trading, as well as manipulating prices or order books. Market-making algorithms are less aggressive in nature; they would only commit to marketing-making behaviors and do not take a speculative position in the assets they trade.

The increasing implementation of algorithmic trading can be attributable to several factors, namely the progression of technology as well as the better design of strategies. With the advent of cloud services, cloud-based algorithmic trading platforms have played a significant role in the market's growth, owing to the plethora of benefits. With the massive success of "pair-trading" strategies algorithms coupled with Direct Market Access, Algorithmic Trading has become too alluring for any major trading desk not to go without. In the market, there are a few elements that act as barometers to measure the quality of the market, and these elements would include the liquidity of the security, the cost of the trade, as well as the volatility of the instrument traded. This research shall explore the impacts of Algorithmic Trading on the market and whether it is beneficial to the entire market. While some studies found that Algorithmic Trading undermines efficient capital allocation, it too increases liquidity, lowers trading cost, and improves price discovery, which improves markets as a whole.

Impacts on Liquidity

Liquidity is a measure of the efficiency and ease of converting a said asset into ready cash without affecting the current market price, this reflects the intrinsic value of the asset. This has been a traditional measure of market quality; the more liquidity present in the market, the more efficient a market is, as less value will be eroded from traders taking unfavorable prices when executing orders.

Although the exact explanation of why algorithmic trading is under much debate, one theory is that these Algorithms have already calculated the underlying intrinsic value and are willing to supply liquidity at prices that are outside the ranges of the intrinsic value for a profit.

A common misconception is that as more algorithmic traders are in the system, they would have a tendency to snatch up liquidity by manipulating the order book, hence widening the spread. A theoretical scenario is that specific algorithms are mainly used to demand liquidity, and they are able to better identify and capture arbitrage opportunities from an In-the-money Option. Thus, that will increase the costs of providing that option, in which case will increase the spread further to compensate.

However, this is merely a misconception. According to research, it is found that Proprietary Algorithmic Trading and High-Frequency Trading Algorithms increase their supply of liquidity in reaction to stock-specific volatility but remain neutral to market volatility. This means that not only would algorithmic traders not snatch up liquidity but, on the contrary, would increase the liquidity supply to reflect the asset's correct intrinsic value.

Although the scope of the above research was only limited to the National Stock Exchange of India, it is also observed that with the presence of Algorithmic trading in *1082* NYSE listed stocks, the average spread narrows by *0.53* basis points. The empirical data of narrowing spreads are also supported by other research papers (refer to figure 1 & 2.)

**Figure 1: Bid-Ask Spreads on Dow Jone Stocks**

Note: Reprinted from Jones (2013). Shows a general decline in spreads from the 1970s to the 2000s

The improvement in liquidity is not only exclusive to the equity markets but also observed in the Australian Stock Exchange Futures as well. In a research paper, it is observed that the presence of ATs in the market is an inverse U shape, where its presence peak in the middle of the day while it wanes near the opening and closing times. At the same time, the effective half spread is of a U shape, where it starts off at *1.44* basis points, narrowing to *1.30* at midday, before reversing direction back to *1.58* at closing. This demonstrates an inverse relationship between the presence of ATs and Spreads, suggesting that ATs improve liquidity by reducing spread.

With a tighter spread following the adoption of algorithmic trading into the market, this translates to asset prices that more accurately reflect the intrinsic value, thus improving markets as a whole.

Figure 2: Effective spread and adverse selection component of spreads over time.
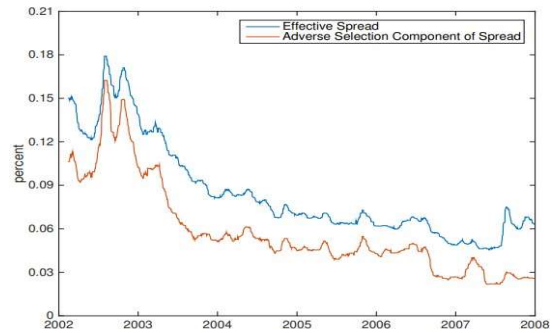
Note: Reprinted from Lyle et al. (2015, p. 37). Shows decline in effective spreads from 2003 to 2008

Impacts on Costs

Besides improving liquidity, Algorithmic Trading systems can also lower associated trading costs. Costs can include from developing the algorithm to the actual trading cost applied by the broker. These trading costs can be significant. It is shown that, on average, a "per unit trading cost" can range up to 164 Basis Points. While the cost to develop Algorithms is often proprietary information, the scarcity of the number of firms using it can be used to infer that the barrier to entry to the world of algorithmic trading is a high one. Not only must a firm have its best quantitative analyst that is able to act as an algorithm's mind, but also the best developers who are adept in computer and logic to make such masterpieces into a reality.

Algorithmic Traders that are specialized for market-making can better seek out hidden liquidity in the market, thus leading to a tighter spread and "Cost Savings" derived from the difference between the prices with and without Algorithmic Trading. This is also supported by another research paper. In the paper, The Adoption of Algorithmic Trading, the data has shown that Buy-side Institutions have begun adopting Algorithmic Trading in their operations at an increasing rate.

Among the reasons given is to reduce overall trading costs. Another aspect that has been shown to reduce expenses of executing trades using Algorithmic trading is by reducing monitoring costs. Algorithmic Trading systems have drastically reduced the amount of time taken for markets to react to news events and have also increased the speed of executions, this feature of ATs has a superior edge as compared to its human counterparts. These machines can take in and process vast amounts of data points much faster than humans. Hence, Algorithmic Traders can significantly reduce the monitoring costs. By having a faster processing speed than humans, they can simultaneously process information from various sources that will help them set more efficient prices.

Retail traders have also started to benefit from these reductions in costs; retail brokerages like Robinhood Markets Inc. have been able to operate and sustain a zero-commission business model by routing their client's orders to Citadel Securities. In return for receiving Robinhood's order flow, Citadel compensates Robinhood, thus offsetting any costs that Robinhood may incur. Thus, Algorithmic Trading system can be a force in improving the market as a whole.

Impacts on Price Discovery

Another aspect that has improved since the advent of Algorithmic Trading in markets is the improvement in the price discovery process. Price Discovery at its core is setting the right spot price for a given asset. It involves finding where supply and demand meet. A wide variety of factors can influence price discovery. Among these is the stage of market development, the market structure, asset type, and current public information available in the market.

Traders with the fastest and most accurate information will have an advantage as they can act before others process that information. When new information arrives, it will theoretically change both the current and future outlook of the market and thus change the price at which both sides are willing to trade.

With Algorithmic Traders, the speed at which these systems process information from multiple sources in calculating and posting the orders of the theoretical fair price is shortened significantly. Once price inefficiencies arise in the market, Algorithmic Traders would quickly act to make them "disappear" by trading on posted quotes, thus restoring the security to its intrinsic value.

The improvement of price discovery is also accelerated by algorithmic traders who specialize in providing liquidity. They make prices more informationally efficient by submitting quotes that reflect new information in real-time, thus mitigating arbitrage opportunities from occurring in the market. This improvement is evident in a study, where the average Information Share, a measure of information efficiency, increases significantly when a proxy measurement for AT presence is in the market. While in the control sample, the Information Shares did not change significantly due to the absence of ATs. Thus, this indicates that ATs do contribute to the improvement of market quality by accelerating and improving the price discovery process.

Impacts on Market Efficiency

One argument is that it can increase market efficiency by quickly executing trades and reducing the impact of human emotions on trading decisions.

When trades are executed quickly, it can help to reduce the impact of market manipulation and ensure that prices reflect the true value of financial instruments. This can lead to more accurate pricing and a more efficient market overall. Additionally, by automating the trading process, algorithmic trading can help to reduce the potential for human error, which can occur when traders make mistakes or act impulsively. This can lead to more consistent and reliable trading results. Research shows that the asymmetry of volatility of stock return attributed to the inefficiency of information can be diminished by using algorithmic trading .

Overall, proponents of algorithmic trading argue that it can help to improve the efficiency and accuracy of financial markets by reducing the influence of human emotions and minimizing the potential for human error.

Other Minor Impacts

There were also other studies that showed that Algorithmic trading improves the market in other different ways, though the pieces of evidence are being debated or have weak evidence supporting it. In another research paper, it has shown that ATs, due to their rapid adaptive nature, can reduce price volatility. Volatility is a measure of how stable a given asset is; the higher the volatility, the riskier the asset can be. It is usual for more aggressive funds to select a riskier asset to maximize returns; however, taking unnecessary risks would not make sense, and thus with a market without unnecessary volatility will improve the market.

A possible explanation for this phenomenon is due to the fact that liquidity demanding ATs can increase trade initiations when spreads are tighter, while liquidity supplying ATs can also increase its number of limit orders when spreads are larger.

As these are rapid responses to the evolving market conditions, these responses will likely lead to lower volatility in the market. However, this evidence from the research is weak and are not supported in other paper. Hence it may not be a clear improvement for the market. However, in the research paper, the empirical data and conclusion have shown that ATs also increase volatility in the short term, thus contradicting and weakening the argument that ATs can improve the market by lowering volatility.

A Counter Argument

There are also some concerns about the impact of algorithmic trading on the market. One concern is that it can lead to increased market volatility, as high-speed trading algorithms can amplify small price movements and create more rapid price swings. Another concern is that algorithmic traders may have an unfair advantage over individual investors, as they have access to sophisticated trading algorithms and large amounts of computing power.

Conclusion

The increasing advancement of technology has led to multiple to Algorithmic Trading's increasingly widespread adoption throughout the financial industry. The resulting technological leaps have altered the markets, and its securities traded. Many financial institutions are now trading through algorithms. As ATs' impact on the markets is still being studied, research has shown it has generally been beneficial to the markets they operate in, whether the equities or futures. While not studied in research yet, can create positive effects in other markets as it is likely that Algorithmic Trading can also improve linkages between these markets.

Unfortunately, due to the immense profitability and its high cost of development, ATs are usually not of public information, and their exact behaviors are hidden behind the corporate veil. The forms which it comes in are also very broad and often overlapping different strategies together. In most markets, it is difficult to unambiguously determine whether a human or algorithm sends out an order so, the majority of research papers does not directly use AT presence as a variable but instead proxy variables such as the number of electronic messages or the types of orders. Thus, research data cannot be entirely sure that markets that demonstrated improvements over time are a direct causality of Algorithmic Trading.

Currently, there is a growing focus over whether Algorithmic Trading and High-Frequency trading systems should be monitored and, in certain instances, restricted through regulation, and this research paper has some important policy implications for authorities and market regulators who should consider algorithms as an integral part of the market in this day and age. These policies can include the restriction of trading activities such as latency arbitrage or frontrunning, as these can contribute to the deterioration of market quality when left unchecked. Regulators may find empirical evidence from this research as another reason to develop its algorithmic trading industry in their respective jurisdictions to promote better market quality for all market participants.

As with any investment strategy, it is important for investors to carefully consider the potential benefits and drawbacks before deciding whether algorithmic trading is right for them.

Writer's Opinions

All is Fair

As a retail trader I believe that algorithmic trading can be beneficial to the markets as market participants who employ AT will be able to improve the efficiency in the markets and thus hasten the process of securities moving toward the "Theoretical price" . In these scenarios retail investors like me, whom do not command as much agency in the market will be able to enter positions at the most fair price.

As Algorithmic trading systems also reduce transaction cost, these savings are also transferred to other retail traders as well. Although retail traders may not incur as much transactional cost as institutional participants, these savings may enable more fund than turnovers in the retail trading space which in turn contributes to the overall market efficiency.

The only disadvantage of a market with high participation rate of ATs is that there will be an increase risks in flash crash occurrences where retail traders have no time to react to. However with the correct regulations by authorities, such risks can be reduced.

Overall, it seems that algorithmic trading has both positive and negative effects on financial markets. Its impact on the market as a whole will likely depend on how it is regulated and how it is used by market participants.

Given the right regulations and accountability of market participants, Algorithmic Trading systems improves market as a whole as they facilitate the market to be more efficient. Thus providing market participants to the most 'Accurate' price.

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